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ANNOUNCEMENT
OF THE
LAWRENCE SCIENTIFIC SCHOOL
OF
HARVARD UNIVERSITY

Second Edition



1896

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1885

1896.							1897.													
JULY.							JANUARY.							JULY.						
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SCIENTIFIC SCHOOL CALENDAR.

1896.

- Sept. 30, Wednesday.* Registration of Scientific School Students.
- Oct. 1, Thursday.* Academic Year begins in all departments of the University. Registration of Scientific School Students continued.
- Oct. 31, Saturday.* Last day for receiving dissertations for the Bowdoin Prize.
- Nov. 26, Thursday.* Thanksgiving Day: a holiday.

RECESS FROM DEC. 23, 1896, TO JAN. 2, 1897, INCLUSIVE.

1897.

- Feb. 15, Monday.* Second half-year begins.
- Feb. 22, Monday.* Washington's Birthday: a holiday.
- March 1, Monday.* Last day for receiving applications of candidates for Final Honors in Natural History in 1898.
- March 31, Wednesday.* Last day for re-engaging College Rooms for 1897-98.

RECESS FROM APRIL 18 TO APRIL 24, INCLUSIVE.

- May 1, Saturday.* Last day for receiving theses of candidates for the degree of S.D.
- May 1, Saturday.* Last day for receiving dissertations for the Dante, Paine, Toppan, and Sumner Prizes.
- May 1, Saturday.* Last for receiving application for College Rooms for 1897-98.
- May 4, Tuesday.* Assignment of College Rooms for 1897-98.
- May 30, Sunday.* Memorial Day.
- May 31, Monday.* A holiday (Memorial Day Exercises).
- June 1, Tuesday.* Last day for receiving applications for Scientific School and Law School Scholarships for 1897-98.

- June 25, Friday.* Senior's Class Day.
- June 29, July 1, 2, 3, Tuesday to Saturday.* Examinations for admission to Harvard College, and to the Lawrence Scientific School.
- June 30, Wednesday.* Commencement.
- SUMMER VACATION OF THIRTEEN WEEKS, FROM COMMENCEMENT DAY TO SEPTEMBER 30, INCLUSIVE.
- July 6, Tuesday.* Summer School opens.
- Sept. 22, 23, 24, 25, Wednesday to Saturday.* Examinations for admission to Harvard College, and to the Lawrence Scientific School.
- Sept. 29, Wednesday.* Registration of Scientific School Students.
- Sept. 30, Thursday.* Academic Year begins in all departments of the University.
- Nov. 25, Thursday,* Thanksgiving day : a holiday.

DEPARTMENTS OF HARVARD UNIVERSITY.

The University comprehends the following departments :—

HARVARD COLLEGE,
THE LAWRENCE SCIENTIFIC SCHOOL,
THE GRADUATE SCHOOL,
THE DIVINITY SCHOOL,
THE LAW SCHOOL,
THE MEDICAL SCHOOL,
THE DENTAL SCHOOL,
THE SCHOOL OF VETERINARY MEDICINE,
THE BUSSEY INSTITUTION (a School of Agriculture),
THE ARNOLD ARBORETUM,
THE UNIVERSITY LIBRARY,
THE MUSEUM OF COMPARATIVE ZOOLOGY,
THE UNIVERSITY MUSEUM,
THE BOTANIC GARDEN,
THE HERBARIUM,
THE ASTRONOMICAL OBSERVATORY.

THE PRABODY MUSEUM OF AMERICAN ARCHAEOLOGY AND ETHNOLOGY
is a constituent part of the University ; but its relations to it are
affected by peculiar provisions.

Students in regular standing in any one department of the University are admitted free to the instruction and the examinations given in any other department, with the exception of exercises carried on in the special laboratories. (This rule does not apply to Special nor to Graduate Students unless they pay the full fee of \$150 a year.)

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10 A.M.

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Recorder of the Faculty of Arts and Sciences: GEORGE W. CRAM, A.B.

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Saturday 9 A.M. to 12 M.

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Office, 16 University Hall, Cambridge. Office hours, daily, 9 A.M.,
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- Secretary of the Lawrence Scientific School*: MONTAGUE CHAMBERLAIN.
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Saturday, 9 A.M. to 1 P.M.
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Office, Harvard Medical School, corner of Boylston and Exeter
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The Dental School is on North Grove Street, Boston. The office
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Curator of the Dental Museum: WALDO E. BOARDMAN, D.M.D.

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Superintendent of the Bussey Farm: EDMUND HERSEY.

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The Jefferson Physical Laboratory is on Holmes Field, Cambridge.

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Curator of the Peabody Museum of Archaeology and Ethnology: FRED-
ERICK W. PUTNAM, A.M., S.D.

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The Fogg Museum of Art is on Kirkland Street, Cambridge.

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Director of the Botanic Garden: GEORGE L. GOODALE, M.D., LL.D.

The Herbarium and Botanic Garden are at the corner of Garden
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Director of the Astronomical Observatory: EDWARD C. PICKERING, LL.D.

The Observatory is at the corner of Garden and Bond Streets,
Cambridge.

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† The term expires, in each case, on Commencement Day of the year indicated.

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Griggs, Thomas Watson,	2	Mining,	<i>Davenport, Ia.</i>
Grinnell, Edmund,	1	Arch.	<i>New Bedford.</i>
Hager, William Perry,	S.	Mech. Engin.	<i>So. Deerfield.</i>
Hanna, Albert Smith,	3	B. & Z.	<i>Albion, Ill.</i>
Harding, Charles Lewis,	1	Mech. Engin.	<i>Boston.</i>
Harley, Frederick William,	1	Gen. Sci.	<i>Fall River.</i>
Harley, Harry Boyd,	S.	Chem.	<i>Fall River.</i>
Harper, Walter Richmond,	S.	Civ. Engin.	<i>Lowell.</i>
Harris, Albert,	1	Mech. Engin.	<i>Cambridge.</i>
Harris, Wilbur Andrew,	1	Mech. Engin.	<i>Swampscott.</i>
Hastings, Theodore Mitchell,	2	Arch.	<i>Philadelphia, Pa.</i>
Hatch, Arthur Edwin,	2	Elec. Engin.	<i>Lowell.</i>
Hatch, Cyril Henry,	1	Geol.	<i>Philadelphia, Pa.</i>
Hawkins, Don Price,	2	Civ. Engin.	<i>Indianapolis, Ind.</i>
Hawkins, Guy Edward,	1	Gen. Sci.	<i>Indianapolis, Ind.</i>
Hawks, Arthur Stearns,	S.	Mech. Engin.	<i>Deerfield.</i>
Herman, Leopold Henry Penniman,	1	Geol.	<i>Brookline.</i>
Hewitt, Harry Brewer,	2	Gen. Sci.	<i>Menasha, Wis.</i>
Hickman, William Albert,	2	B. & Z.	<i>Pictou, N. S.</i>
Hodges, Arthur Webster,	3	Elec. Engin.	<i>Newton Centre.</i>
Hodges, Richard Osgood,	2	Mech. Engin.	<i>New York, N. Y.</i>
Hodges, William Joseph,	1	Elec. Engin.	<i>Newton Centre.</i>
Hollander, Sumner Russ,	1	Gen. Sci.	<i>Boston.</i>
Hollings, William French,	1	Arch.	<i>Newtonville.</i>
Holmes, Howard Fowler,	2	Hyg.	<i>Georgetown.</i>
Holmes, Jonathan Hiller,	S.	Gen. Sci.	<i>Elmira, N. Y.</i>

Hopkins, Stephen Upshur,	4	Civ. Engin.	<i>Onancock, Va.</i>
Howe, Charles Roswell,	1	Elec. Engin.	<i>Olean, N. Y.</i>
Hoyt, Giles Milton,	2	Elec. Engin.	<i>Danbury, Conn.</i>
Hughes, Harold Lincoln,	1	Mech. Engin.	<i>Saugus.</i>
Humphrey, Campbell,	1	Gen. Sci.	<i>Brookline.</i>
Hunt, Herbert Leavitt,	S.	Gen. Sci.	<i>New York, N. Y.</i>
Hurley, Charles Ambrose,	2	Geol.	<i>Lynn.</i>
Hurley, John Christopher,	1	Civ. Engin.	<i>Charlestown.</i>
Hurt, James Cecil,	S.	Hyg.	<i>Kansas City, Mo.</i>
Irvin, Effingham Townsend,	1	Geol.	<i>New York, N. Y.</i>
Irwin-Martin, Clinton Richard,	1	Geol.	<i>New York, N. Y.</i>
Jaffray, Percy Malcolm,	2	Elec. Engin.	<i>Irvington-on-Hud-</i>
Jefferson, Mark Sheldin William,			<i>[son, N. Y.]</i>
A.B. (<i>Boston Univ.</i>) 1879,	2	Geol.	<i>Lexington.</i>
Johnson, Herbert Ray,	1	Mech. Engin.	<i>St. Louis, Mo.</i>
Johnson, Roswell Hill,	1	B. & Z.	<i>Buffalo, N. Y.</i>
Johnson, William Nelson,	1	Mech. Engin.	<i>Mattapoisett.</i>
Johnston, Charles Haven Ladd,	2	Hyg.	<i>Washington, D. C.</i>
Johnston, Samuel Andrew, Jr.	S.	Gen. Sci.	<i>Indianapolis, Ind.</i>
Jones, Isaiah Tobey,	3	Mech. Engin.	<i>Sandwich.</i>
Kelsey, William Hargrave,	4	Gen. Sci.	<i>Cambridge.</i>
Kendall, Hugh Fessenden,	3	Geol.	<i>Cambridge.</i>
Kennedy, Frank Lowell, A.B. 1892,	3	Mech. Engin.	<i>Cambridge.</i>
Kidder, Howard White,	1	Mining,	<i>Cambridge.</i>
Kimball, George Cook,	1	Elec. Engin.	<i>Brookline.</i>
Kingan, Robert William James,	1	Gen. Sci.	<i>New York, N. Y.</i>
Kingsbury, Isaac William, A.B.			
1896,	3	Mining,	<i>Chestnut Hill.</i>
Knap, Allen Howe, M.E. (<i>State</i>			
<i>Normal School, Mansfield, Pa.</i>)			
1888,	4	Sci. T.	<i>Cambridge.</i>
Ladd, Charles Haven,	1	Gen. Sci.	<i>Galveston, Tex.</i>
Lake, Frank Bourne,	S.	Mech. Engin.	<i>Cambridge.</i>
Lawson, Daniel Lamont, A.B.			
(<i>Fisk Univ.</i>) 1895,	2	Gen. Sci.	<i>Louisville, Ky.</i>
Lee, Edward Brown,	S.	Arch.	<i>W. Somerville.</i>
Leonard, Merton Channing,	3	Sci. T.	<i>Bridgewater.</i>
Leupp, Graham Murdock,	S.	Gen. Sci.	<i>Washington, D. C.</i>
Lewin, Frank Spalding,	S.	Hyg.	<i>Brooklyn, N. Y.</i>
Lewis, Fred Charles,	4	Elec. Engin.	<i>W. Superior, Wis.</i>
Libbey, Joseph Harold,	3	Mech. Engin.	<i>W. Newton.</i>
Locke, James Pillsbury,	1	Civ. Engin.	<i>Waltham.</i>
Lockwood, Cornelius Wygant,	2	Gen. Sci.	<i>Newburgh, N. Y.</i>

Luscomb, Henry Martin,	1	Mech. Engin.	<i>Bridgeport, Conn.</i>
McCaffrey, Charles Francis,	2	Chem.	<i>Somerville.</i>
McCarthy, Edward Eugene,	4	Mining,	<i>Cambridge.</i>
(McClare, Charles Herbert,	S.	Arch.	<i>Arlington.</i>
McClintock, John Tilton,	2	Arch.	<i>Dorchester.</i>
M'Coy, George Madison, Jr.	S.	Chem.	<i>Melrose.</i>
McHenry, Wallace Estill,	1	Gen. Sci.	<i>St. Louis, Mo.</i>
McLean, George Samuel Read,	1	Arch.	<i>Cambridge.</i>
McMurtry, George Gibson, 2d,	2	Geol.	<i>Allegheny City, Pa.</i>
McNary, Charles Herbert,	S.	Elec. Engin.	<i>Newark, N. J.</i>
McNaught, Roy Hyde,	1	Geol.	<i>New York, N. Y.</i>
McNiel, Walter William,	S.	Gen. Sci.	<i>Elgin, Ill.</i>
Maniere, George,	1	Gen. Sci.	<i>Chicago, Ill.</i>
Manning, Charles Bartlett,	1	Mech. Engin.	<i>Manchester, N. H.</i>
Marshall, John Francis,	2	Mech. Engin.	<i>Cambridge.</i>
Martin, Kenneth McGeoch,	1	Elec. Engin.	<i>Milwaukee, Wis.</i>
Mason, Albert Gardner,	1	Gen. Sci.	<i>Worcester.</i>
Massa, Robert Falconer, A.B.			
(<i>Obertin Coll.</i>) 1895,	3	Mech. Engin.	<i>Kansas City, Mo.</i>
Maury, John William Draper,	4	B. & Z.	<i>New York, N. Y.</i>
Mayo, Wyndham Robertson, Jr.	1	Geol.	<i>Norfolk, Va.</i>
Meador, Herman Lee,	2	Arch.	<i>New Orleans, La.</i>
Mendenhall, Walter Curran, S.B.			
(<i>Ohio State Normal</i>) 1891,	S.	Geol.	<i>Limaville, O.</i>
Mercure, George T Johns,	S.	Arch.	<i>Rutland, Vi.</i>
Meyer, Albert Richard,	S.	Elec. Engin.	<i>Brookline.</i>
Mills, Samuel Frederick,	S.	Geol.	<i>West Point, N. Y.</i>
Miskell, Thomas Lawrence,	S.	Hyg.	<i>Brookline.</i>
Moeller, Edward Heine,	S.	Arch.	<i>Buffalo, N. Y.</i>
Moline, Charles,	1	Hyg.	<i>Sunderland.</i>
Montague, Samuel Skerry,	4	Mech. Engin.	<i>Oakland, Cal.</i>
Moore, Henry Bailey,	1	Elec. Engin.	<i>Yonkers, N. Y.</i>
Moore, Ralph Spencer,	1	Mech. Engin.	<i>Cambridge.</i>
Morrill, Charles Herbert,	1	Geol.	<i>No. Andover.</i>
Morris, Davis Harrington,	4	Civ. Engin.	<i>Chicago, Ill.</i>
Morse, Elisha Wilson,	S.	Gen. Sci.	<i>Boston.</i>
Mortland, Walter Guy,	S.	Mining,	<i>Allegheny City, Pa.</i>
Morton, Alex Amerton,	4	Elec. Engin.	<i>Wakefield.</i>
Moses, Ernest Maebry,	3	Civ. Engin.	<i>Urbana, O.</i>
Moses, Herbert Wallis,	1	Elec. Engin.	<i>Chelsea.</i>
Moulton, John Babcock,	2	Chem.	<i>Boston.</i>
Mowll, William Luther,	1	Arch.	<i>Cambridge.</i>
Moyer, James Ambrose,	2	Elec. Engin.	<i>Norristown, Pa.</i>

Nash, Howard Patterson,	S. Elec. Engin.	<i>Titicus, Conn.</i>
Nazro, William Edward Coffin,	S. Arch.	<i>Dorchester.</i>
Newton, Frederick Maurice,	S. Gen. Sci.	<i>New York, N. Y.</i>
Norton, Arthur Orlo,	4 Sci. T.	<i>Stillman Valley, Ill.</i>
O'Connor, William Morgan,	2 Mining,	<i>San Francisco, Cal.</i>
Oglesby, John Dean Gillett,	1 Hyg.	<i>Elkhart, Ill.</i>
O'Neill, Bernard Joseph, Jr.	1 Hyg.	<i>Dubuque, Ia.</i>
Outerbridge, Samuel Roosevelt,	4 Civ. Engin.	<i>New York, N. Y.</i>
Page, John Hicock,	1 Mech. Engin.	<i>Rutland, Vi.</i>
Page, Logan Waller,	S. Geol.	<i>Cambridge.</i>
Parker, Gordon Saltonstall,	1 Arch.	<i>Cambridge.</i>
Parker, Harry Caldwell,	S. Hyg.	<i>Dubuque, Ia.</i>
Parker, William Stanley,	2 Arch.	<i>Longwood.</i>
Partridge, Warren,	4 Elec. Engin.	<i>Newton.</i>
Pearce, Arthur Cushing,	1 Hyg.	<i>Somerville.</i>
Percival, Arthur William,	4 Mech. Engin.	<i>Millbury.</i>
Phelps, William Henry,	4 B. & Z.	<i>New York, N. Y.</i>
Phillips, John Charles,	2 B. & Z.	<i>Boston.</i>
Phippen, Walter Gray,	1 Hyg.	<i>Salem.</i>
Pierce, Hugh Clay,	2 Elec. Engin.	<i>Buffalo, N. Y.</i>
Pierpont, George Walker,	2 Gen. Sci.	<i>Chicago, Ill.</i>
Porter, Augustus Granger,	S. Civ. Engin.	<i>Niagara Falls, N. Y.</i>
Prall, Ralph Taylor,	S. Mech. Engin.	<i>Cleveland, O.</i>
Pray, James Sturgis,	S. Arch.	<i>Cambridge.</i>
Presby, George Watson,	1 Mech. Engin.	<i>Waltham.</i>
Procter, John Robert, Jr.	3 Arch.	<i>Washington, D. C.</i>
Pruyn, Edward Lansing,	2 Gen. Sci.	<i>Albany, N. Y.</i>
Purington, Frank Howard,	2 Arch.	<i>Boston.</i>
Quayle, George Harland,	S. Mech. Engin.	<i>Cleveland, O.</i>
Rawle, Francis, Jr.	S. Gen. Sci.	<i>Philadelphia, Pa.</i>
Read, William, 2d,	2 Gen. Sci.	<i>Cambridge.</i>
Reed, Frank Nutting,	1 Mech. Engin.	<i>Cambridge.</i>
Reynolds, Laurence Russell,	1 B. & Z.	<i>W. Newton.</i>
Rice, Arthur Waldo,	1 Geol.	<i>Boston.</i>
Rich, Edwin Willis,	4 Hyg.	<i>Boston.</i>
Rich, Walter Sears,	2 Civ. Engin.	<i>Boston.</i>
Richards, George Lawrence,	S. Civ. Engin.	<i>New York, N. Y.</i>
Richards, John Bradford,	3 Mech. Engin.	<i>Andover.</i>
Richards, Oliver Filley,	1 Gen. Sci.	<i>St. Louis, Mo.</i>
Rieman, Paul Edward,	1 Sci. T.	<i>Cambridge.</i>
Ring, Henry Constant,	2 Arch.	<i>Winthrop High'ds.</i>
Robinson, Frank Duane,	2 Elec. Engin.	<i>Oneonta, N. Y.</i>
Robinson, Harry Pringle,	S. Hyg.	<i>Plattsburg, N. Y.</i>

Robinson, Porter Osgood,	2	Mech. Engin.	<i>Cambridge.</i>
Roche, James Thomas, Jr.	2	Mech. Engin.	<i>Worcester.</i>
Rockwell, Albert John,	1	Gen. Sci.	<i>Warren, Pa.</i>
Ross, Wayland,	S.	Gen. Sci.	<i>Cambridge.</i>
Ruland, Norman,	1	Arch.	<i>Brooklyn, N. Y.</i>
Rumery, Ralph Rollins,	2	Civ. Engin.	<i>Portland, Me.</i>
Russell, Harry Browning,	S.	Arch.	<i>Brockton.</i>
Rust, Nathaniel Johnson,	1	Mech. Engin.	<i>Boston.</i>
Ryan, Michael Healy,	2	Civ. Engin.	<i>Lynn.</i>
Saldaña, Eduardo Egberto,	4	Mech. Engin.	<i>San Juan, Porto Rico.</i>
Salomon, Solomon Gustav,	S.	Gen. Sci.	<i>New York, N. Y.</i>
Sanborn, James Forrest,	2	Mining,	<i>Cambridge.</i>
Sanborn, Robert Alden,	S.	Chem.	<i>Malden.</i>
Sanchez, Carlos,	1.	Hyg.	<i>Nuevitas, Cuba.</i>
Sanders, William Huntington,	3	Gen. Sci.	<i>Salem.</i>
Schwarzenberg, Eugene Merton,	2	Mech. Engin.	<i>Boston.</i>
Selfridge, Harold,	3	Mech. Engin.	<i>Washington, D. C.</i>
Shepardson, Ernest Warren,	2	Civ. Engin.	<i>Everett.</i>
Sherman, Carleton Farrar,	2	Civ. Engin.	<i>Jamaica Plain.</i>
Shertzer, Tyrell Bradbury,	1	Civ. Engin.	<i>Baltimore, Md.</i>
Sherwin, Robert Waterston,	2	Elec. Engin.	<i>Jamaica Plain.</i>
Sleeper, Stephen Wescott,	2	Gen. Sci.	<i>Boston.</i>
Slocum, Curlys Lyon,	2	Civ. Engin.	<i>New London, Conn.</i>
Smith, Albert Ross,	2	Mech. Engin.	<i>Chelsea.</i>
Smith, Frederick Estabrook, Jr.	1	Arch.	<i>Dayton, O.</i>
Smith, George Washington,	2	Arch.	<i>Fredericksburg, Va.</i>
Smoot, Charles Head,	1	Mech. Engin.	<i>Brookline.</i>
Snow, Clarence,	4	Elec. Engin.	<i>St. George, Utah.</i>
Souther, Allan Bartlett,	4	Mech. Engin.	<i>Somerville.</i>
Spalding, Roger, .	3	Hyg.	<i>Cambridge.</i>
Stevens, Charles Goold,	S.	Hyg.	<i>Lynn.</i>
Stevens, Edward Winslow,	2	Elec. Engin.	<i>Cambridge.</i>
Stevens, Sidney,	1	Mech. Engin.	<i>Ludlow.</i>
Stevens, Samuel Barron,	3	Gen. Sci.	<i>Rome, N. Y.</i>
Stevenson, William Freeman,	4	Civ. Engin.	<i>Greenville, N. H.</i>
Steward, George Henry,	S.	Mech. Engin.	<i>E. Clarendon, Vt.</i>
Stiles, Chester Franklin,	3	Chem.	<i>Cambridgeport.</i>
Stott, Charles Williams,	1	Geol.	<i>Lowell.</i>
Sturgis, Arthur Barney,	1	Elec. Engin.	<i>New York, N. Y.</i>
Swan, Walter Dana,	S.	Arch.	<i>Cambridge.</i>
Symonds, Harvey Danforth,	1	Civ. Engin.	<i>Phoenix, Ariz.</i>
Taggart, Howard Ward,	2	Mech. Engin.	<i>So. Orange, N. J.</i>
Talbot, Charles Nicoll, Jr.	2	Gen. Sci.	<i>New York, N. Y.</i>

Taylor, Cecil Hamelin,	1 Mining,	<i>Philadelphia, Pa.</i>
Taylor, George Robert,	2 Elec. Engin.	<i>Youngstown, O.</i>
Terbush, Myron Emmet,	S. Elec. Engin.	<i>Owego, N. Y.</i>
Teung, Chan Loon,	4 Chem.	<i>China.</i>
Thayer, Cranston Swift,	1 Elec. Engin.	<i>Cambridge.</i>
Thomson, Clarke,	2 Civ. Engin.	<i>Merion Station, Pa.</i>
Tozier, Charles Herman,	3 Hyg.	<i>Somerville.</i>
Vaux, Henry Pepper,	1 Civ. Engin.	<i>Penlllyn, Pa.</i>
Verveer, Emanuel,	3 Civ. Engin.	<i>Boston.</i>
Wadsworth, Arthur Clinton,	4 Sci. T.	<i>Cambridge.</i>
Walker, Alexander Stewart,	2 Arch.	<i>Chicago, Ill.</i>
Wallace, Henry Whiting,	S. Mech. Engin.	<i>Steubenville, O.</i>
Ward, Harry C,	2 Elec. Engin.	<i>Greenfield, Tenn.</i>
Ware, John,	2 Civ. Engin.	<i>E. Milton.</i>
Warren, Leicester,	1 Mech. Engin.	<i>Cambridge.</i>
Waterman, John Slater,	2 Hyg.	<i>E. Greenwich, R. I.</i>
Watson, James Otis, Jr.	S. Mining,	<i>Fairmont, W. Va.</i>
Watson, R. Hopkins,	1 Mining,	<i>W. Somerville.</i>
Webster, Ira Gilbert,	S. Mech. Engin.	<i>New Albany, Ind.</i>
Wells, James Ogden,	S. Elec. Engin.	<i>St. Joseph, Mich.</i>
Wheeler, Stuart Wadsworth,	2 Hyg.	<i>Philadelphia, Pa.</i>
White, Charles Henry, s.b. (<i>Univ.</i> <i>of No. Carolina</i>) 1894,	4 Geol.	<i>Ledger, N. C.</i>
White, Richard Albert,	2 Elec. Engin.	<i>Cove City, Ky.</i>
Whitfield, Howard Clarke,	1 Geol.	<i>Chicago, Ill.</i>
Whitfield, Henry Davis,	2 Arch.	<i>New York, N. Y.</i>
Whiting, Robert Rudd,	1 Gen. Sci.	<i>New York, N. Y.</i>
Whitman, Clarence Morton,	2 Gen. Sci.	<i>New York, N. Y.</i>
Whitney, George Brackett,	2 Mech. Engin.	<i>Newton.</i>
Whitney, Parker,	1 Gen. Sci.	<i>Boston.</i>
Whittall, Matthew Percival,	1 Mech. Engin.	<i>Worcester.</i>
Whorf, Stephen Cook,	2 Mech. Engin.	<i>Provincetown.</i>
Wilcock, Frederick,	1 Civ. Engin.	<i>Brooklyn, N. Y.</i>
Wilder, Frederic Mason,	1 Geol.	<i>Brownville, Me.</i>
Wilder, Henry Merrill, A.B. (<i>Bow-</i> <i>doin Coll.</i>) 1893,	3 Elec. Engin.	<i>Brownville, Me.</i>
Wilcutt, Joseph Nicolas,	S. Arch.	<i>Cohasset.</i>
Williams, Charles Hoyt,	2 Elec. Engin.	<i>Buffalo, N. Y.</i>
Williams, Hermann Warner,	2 Arch.	<i>Boston.</i>
Williams, Lombard,	3 Arch.	<i>Buffalo, N. Y.</i>
Williams, Simon Everard,	S. Chem.	<i>Mt. Vernon, N. Y.</i>
Williams, Sydney Stewart,	1 Gen. Sci.	<i>Chicago, Ill.</i>
Wilson, Louis Thornton,	2 B. & Z.	<i>Worcester.</i>

Wilson, Ralph Graham,	2	Gen. Sci.	<i>Germantown, Pa.</i>
Wolbach, Edwin Joseph,	2	Chem.	<i>Grand Island, Neb.</i>
Wood, John William, Jr.	3	Mech. Engin.	<i>Cambridge.</i>
Wood, Sabine Wallingford,	8.	Arch.	<i>Bangor, Me.</i>
Woods, Charles Royal,	1	Elec. Engin.	<i>Cambridge.</i>
Wright, Augustus Edward,	1	Arch.	<i>Fayetteville.</i>
Young, Ernest Adams,	2	Chem.	<i>Dorchester.</i>

SUMMARY.

FOURTH YEAR STUDENTS	30
THIRD " "	41
SECOND " "	94
FIRST " "	130
SPECIAL " "	80
Total	375
CIVIL ENGINEERING	34
ELECTRICAL ENGINEERING	45
MECHANICAL ENGINEERING	70
MINING AND METALLURGY	13
ARCHITECTURE	48
CHEMISTRY	17
GEOLOGY	31
BOTANY AND ZOOLOGY	16
GENERAL SCIENCE	61
SCIENCE FOR TEACHERS	12
ANATOMY, PHYSIOLOGY, AND PHYSICAL TRAINING	28
Total	375

THE SCIENTIFIC SCHOOL.

ADMISSION.

ADMISSION OF CANDIDATES FOR THE DEGREE OF BACHELOR OF SCIENCE.

Methods of Admission.

Candidates may be admitted by examination or, if they come from other colleges, without complete examination, or with such examinations as the Administrative Board may require. For the latter method, see p. 41.

Examinations for admission are held in June both at Cambridge and at the places named on p. 39; in September at Cambridge only. For the regulations concerning division of the examination between two years or between June and September of the same year, see p. 37. For the hours set for examinations, see p. 40.

Testimonials.

Every candidate for admission is required to furnish a testimonial of honorable dismissal from the school or college which he has attended, or from the tutor with whom he has studied. Testimonials may be presented at the time of the Final Examination. When a candidate has been in regular attendance at a school or academy during the year preceding his Final Examination, a testimonial from a private tutor will not in itself be sufficient.

Certificates.

A certificate of preparation is required of every candidate for a Preliminary Examination. There is a prescribed form for this certificate, see p. 38. No certificate of preparation is required of a candidate for Final Examination, or of one who postpones part of his examination from June to September in the same year.

Notice Required.

Candidates who wish to be examined in any place other than Cambridge, are required to give notice to the Corresponding Secretary of the University. The notice must be in the Secretary's hands not later than June 10. Candidates who intend to take any of the examinations of the first day must mention this intention in their notice.

Fees.

No fee is charged for examination in Cambridge.

A fee of five dollars must be paid *in advance* by every candidate who is examined at any place other than Cambridge. The whole fee of a candidate who purposes to divide his examination is to be paid before his first examination: it should be sent by check, post-office order, or registered letter, to CHARLES F. MASON, Bursar, Cambridge, Mass., and should be in the Bursar's hands not later than June 10.

Persons who do not intend to enter the Scientific School will be admitted to the examinations at places other than Cambridge on payment of a fee of five dollars; and, if successful, will receive certificates to that effect.

Requirements for Admission.

Candidates for admission will be examined in the following subjects: English, German or French, History, Algebra, Plane Geometry, Solid Geometry, Physics.

Candidates who propose to register in the course of General Science must offer either Experimental Physics or Chemistry, and those who propose to register in the course of Chemistry or in the department of Science for Teachers must offer both Experimental Physics and Chemistry.

Candidates for the course of Electrical Engineering and those for the course of Anatomy, Physiology, and Physical Training are advised to offer Experimental Physics.

Candidates for the course of Mining and Metallurgy are advised to offer French and German and Advanced Mathematics.

After the year 1896, candidates for the course of Architecture will be required to offer both the History of Greece and Rome and the History of the United States and England, and Free-hand Drawing in addition to other requirements.

REQUIRED SUBJECTS.

English.—English may be offered either as a Preliminary or as a Final subject, see p. 37. The examination will occupy two hours.

The examination will consist of two parts, which, however, cannot be taken separately:—

I. The candidate will be required to write a paragraph or two on each of several topics chosen by him from a considerable number—perhaps ten or fifteen—set before him on the examination paper. In 1897 the topics will be drawn from the following works:—

Shakspeare's *As You Like It*; Defoe's *History of the Plague in London*; Irving's *Tales of a Traveller*; Hawthorne's *Twice Told Tales*; Longfellow's *Evangeline*; George Eliot's *Silas Marner*.

The candidate is expected to read intelligently *all* the books prescribed. He should read them as he reads other books; he is expected, not to know them minutely, but to have freshly in mind their most important parts. In every case the examiner will regard knowledge of the book as less important than ability to write English.

As additional evidence of preparation, the candidate may present an exercise book, properly certified by his instructor, containing compositions or other written work.

The works prescribed for this part of the examination in 1898, 1899 and 1900 are as follows:—

In 1898: Milton's *Paradise Lost*, Books I and II; Pope's *Iliad*, Books I and XXII; The Sir Roger de Coverley Papers in the *Spectator*; Goldsmith's *Vicar of Wakefield*; Coleridge's *Ancient Mariner*; Southey's *Life of Nelson*; Carlyle's *Essay on Burns*; Lowell's *Vision of Sir Launfal*; Hawthorne's *House of the Seven Gables*.

In 1899: Dryden's *Palamon and Arcite*; Pope's *Iliad*, Books I, VI, XXII, and XXIV; The Sir Roger de Coverley Papers in the *Spectator*; Goldsmith's *Vicar of Wakefield*; Coleridge's *Ancient Mariner*; De Quincey's *Flight of a Tartar Tribe*; Cooper's *Last of the Mohicans*; Lowell's *Vision of Sir Launfal*; Hawthorne's *House of the Seven Gables*.

In 1900: Dryden's *Palamon and Arcite*; Pope's *Iliad*, Books I, VI, XXII, and XXIV; The Sir Roger de Coverley Papers in the *Spectator*; Goldsmith's *Vicar of Wakefield*; Scott's *Ivanhoe*; De Quincey's *Flight of a Tartar Tribe*; Cooper's *Last of the Mohicans*; Tennyson's *Princess*; Lowell's *Vision of Sir Launfal*.

II. A certain number of books will be prescribed for careful study. This part of the examination will be upon subject-matter, literary form, and logical structure, and will also test the candidate's ability to express his knowledge with clearness and accuracy.

The books prescribed for this part of the examination are:

In 1897: Shakspeare's *Merchant of Venice*; Burke's *Speech on Conciliation with America*; Scott's *Marmion*; Macaulay's *Life of Samuel Johnson*.

In 1898: Shakspeare's *Macbeth*; Burke's *Speech on Conciliation with America*; De Quincey's *Flight of a Tartar Tribe*; Tennyson's *Princess*.

In 1899: Shakspeare's *Macbeth*; Milton's *Paradise Lost*, Books I and II; Burke's *Speech on Conciliation with America*; Carlyle's *Essay on Burns*.

In 1900: Shakspeare's *Macbeth*; Milton's *Paradise Lost*, Books I and II; Burke's *Speech on Conciliation with America*; Macaulay's *Essays on Milton and Addison*.

No candidate will be accepted in English whose work is seriously defective in point of spelling, punctuation, grammar, or division into paragraphs.

In connection with the reading and study of the prescribed books, parallel or subsidiary reading should be encouraged, and a considerable amount of English poetry should be committed to memory. The essentials of English grammar should not be neglected in preparatory study.

The English written by a candidate in any of his examination-books may be regarded as part of his examination in English in case the evidence afforded by the examination-book in English is insufficient.

*German or French.** — The translation at sight either of simple German prose, or of ordinary French prose. The passages set for translation will be similar to those set at the final examinations in German A and French A respectively, — College courses, each having three hours of instruction a week through the year. The passages set for translation must be rendered into simple and idiomatic English. A knowledge of the language itself, rather than of the grammar, is expected; but proficiency in elementary grammar or facility in writing the language will be accepted as an offset to some deficiency in translation. It is recommended that from the outset attention be given to pronunciation. Wherever possible, care should be taken, during the whole course of preparation, to accustom the pupil to hear and understand spoken German and French.

History (including Historical Geography). — Either (1) History of Greece and Rome; or (2) History of the United States and of England.

The following works will serve to indicate the amount of knowledge demanded in History: Oman's History of Greece; Allen's History of the Roman People (the whole), or Leighton's History of Rome (to the death of Commodus); Higginson's Young Folks' History of the United States (to the end of Chapter XXI), and Johnston's History of the United States for Schools (beginning at § 269); Guest and Underwood's Handbook of English History (to the year 1793), or Gardiner's Student's History of England through Part IX.

The following selections are recommended for additional reading and will be made the basis of optional questions in the examination: † —

For Greek History: Curtius's History of Greece, Book I, Ch. I, Book II, Ch. IV, and Book III, Ch. III.

For Roman History: Beesly's The Gracchi, Marius, and Sulla; Tighe's Development of the Roman Constitution.

* Candidates from countries in which English is not spoken may defer the entrance examination in French or German to the end of their first year of residence.

† Candidates who take the questions on the Selections will be allowed to omit some of the questions on the corresponding Manual.



For American History: Lodge's English Colonies, Chapters II, and XXII; Morse's John Quincy Adams, Chapters II and III; Josiah Quincy's Figures of the Past.

For English History: Macaulay's History of England, Chapters I and III.

Algebra, through Quadratic Equations. (The requirement in Algebra embraces the following subjects: factors, common divisors and multiples, fractions, ratios and proportions; negative quantities and the interpretation of negative results; the doctrine of exponents; radicals and equations involving radicals; the binomial theorem for positive integral exponents and the extraction of roots; putting questions into equations, and the reduction of equations; the ordinary methods of elimination, and the solution of both numerical and literal equations of the first and second degrees, with one or more unknown quantities, and of problems leading to such equations.)

Plane Geometry.

Solid Geometry. The following book will serve to indicate the nature and amount of the requirements in Solid Geometry:—

Chauvenet's *Geometry*, revised and abridged (Philadelphia: J. P. Lippincott & Co.). Books VI, VII, VIII, and IX.

Physical Science.— Either (1) Astronomy (Young's *Lessons in Astronomy*, Ginn & Co., omitting the appendix) and Physics (Avery's *Elements of Natural Philosophy*,* or Gage's *Elements of Physics*); or (2) a course of experiments not less than forty in number performed at school by the pupil. These must be selected from a list issued by the University under the title of a *Descriptive List of Elementary Physical Experiments*, or must be approved by the Department of Physics as the equivalent of those contained in this list.

The Faculty requests all teachers who can command the necessary apparatus to present their pupils in (2) rather than in (1). (For the character of the examination in (2) see the notes under Optional Subjects.

OPTIONAL SUBJECTS.

In addition to these *required* subjects there are others, given in the following list, which may well be offered by candidates for the Scientific School. They are called Advanced Studies in the requirements for admission to Harvard College.

Students who have passed the examinations at admission in any of these Advanced Studies, or in any studies required in the School, will be given

* The following portions of the 1885 edition may be omitted:—sections I and II of chap. I (excepting arts. 23–30), arts. 254–267, 346–349, 371, 411–415, 445–455, 464–467, 470–476, 707–714, 729–745, and the whole Appendix.

credit for the courses so passed and may substitute for them others chosen with the approval of the Administrative Board.

Logarithms and Trigonometry. Wheeler's Logarithms (Cambridge : Sever) or the unbracketed portions of Peirce's Elements of Logarithms (Boston : Ginn & Co.). Wheeler's Plane Trigonometry (same publishers). Problems in Plane Trigonometry (Cambridge : Sever). Peirce's Mathematical Tables, chiefly to four places (Boston : Ginn & Co.).*

Analytic Geometry. Brigg's Analytic Geometry (New York : Wiley & Co.).

Advanced Algebra. Wentworth's College Algebra (Boston : Ginn & Co.), to article 498, omitting Chapters XIX, XX, XXIV, XXV, XXVII, XXVIII. The examination will be mainly occupied with the portions of Algebra, as thus defined, which are not included in the elementary requirement in Algebra; but elementary questions will not necessarily be excluded.

Physical Science.—Physics. A course of at least sixty experiments in addition to those of Elementary Physics (2), selected from the same or similar manuals, and covering the same subjects, but demanding more skill and more knowledge of physical theories and laws.

Physical Science.—Chemistry. A course of at least sixty experiments in General Chemistry actually performed at school by the pupil.

NOTE-BOOKS AND LABORATORY EXAMINATIONS.

In Elementary Physics (and in Advanced Physics, and in Chemistry, if these subjects are offered), the candidate will be required to pass both a written and a laboratory examination. The written examination will test his knowledge of experiments and experimenting as well as his knowledge of principles and results. The laboratory examination will test his skill in experimenting. The candidate will be required to hand in the original note-book in which he recorded the steps and the results of the experiments which he performed at school; and this note-book must bear the endorsement of his teacher, certifying that the notes are a true record of the pupil's work. The note-book in Physics should contain an index of the exercises which it describes.

A candidate who offers Elementary or Advanced Physics or Chemistry will hand in his laboratory note-book at the hour of the written examination.

Laboratory note-books will be deposited, after examination, in the College office, where they will be kept for a reasonable time, subject to the order of the owners.

* Candidates are required to use at the examinations the four-place tables provided by the University.

A candidate examined in June at any place where a laboratory examination is not provided will be required to take such examination in Cambridge in the autumn on the day and at the place named below (p. 276); but if he passes the written examination in June and presents a satisfactory note-book, the subject will be counted in his favor in determining the question of his admission to the School. Similarly a Preliminary candidate is allowed to postpone his laboratory examination until September of the year in which he enters the School.

Most pupils will need lectures or other oral explanations in addition to the descriptions given in the laboratory manuals. When it is impossible to provide lectures, two text-books treating the subject from different points of view will be advantageous.

Descriptive lists of experiments which will meet the requirements in Physics and Chemistry may be procured (at 40 cents each) of the Harvard Coöperative Society, or of C. W. SEVER, Bookseller, Harvard Square, Cambridge.

EXAMINATION PAPERS.

A set of recent examination papers will be sent free to any address, on application to the Secretary of the School. Separate papers used during the last two years in any subject may be had by the *dozen* (copies or more) of any *one* paper at ten cents a dozen.

Division of the Examination.

A candidate for admission may take the entire examination at one time; or he may divide it, under conditions named below (1) between two years, or (2) between June and September of the same year. In the former case he is known as a "Preliminary Candidate"; in the latter as a "Postponer." Teachers and candidates should carefully distinguish between the words "Preliminary" and "Postponing" as used at examinations for admission, since a careless use of one of these words for the other leads to serious misunderstanding. A Preliminary Examination is always taken a year or more before the Final Examination.

Postponing candidates—those who divide their examinations between June and September of the same year—are considered as taking Final Examinations at both the June and September periods.

1. PRELIMINARY EXAMINATION.

A candidate may pass a Preliminary Examination in some of the subjects and be examined in the remaining subjects in some subsequent year. For the Preliminary Examination the candidate must present himself *in June*, having previously sent in a certificate of preparation; see below. No Preliminary Candidates will be examined in September without special permission from the Dean.

A Preliminary certificate will be granted to any candidate who passes two of the required subjects.

Candidates may offer themselves for the Preliminary Examination in any subjects *in which their teachers certify that they are prepared, and in no others.*

CERTIFICATES OF PREPARATION.

The certificate of preparation for Preliminary candidates must be in the following form:—

"..... has been my pupil for..... years, and is, in my judgment, prepared to pass the Harvard Preliminary Examinations in the following subjects:— . . .
Name of Teacher:..... Name of School:..... Address:....."

When a candidate has been in regular attendance at a school or academy for any part of the year preceding his Preliminary Examination, his certificate must be signed by the principal of that school or academy.

The certificates of Preliminary candidates must be in the hands of the Secretary of the Scientific School on or before June 21.

Candidates who have prepared themselves for the admission examinations should correspond with the Secretary of the School concerning their certificates.

2. POSTPONING.

A candidate who presents himself in June intending to pass the whole examination in the same year may postpone until September a part of his examination, but he will receive no credit for the examination held in June, unless he passes in at least two subjects. Candidates who divide the examination between June and September of the same year must register in June not as *Preliminary* but as *Final* candidates. In September they must present themselves at 8 A.M. on the *first day* of the Examinations, Wednesday, September 22 (see p. 40).

TIMES AND PLACES OF EXAMINATION.

EXAMINATION FOR ADMISSION TO THE FIRST-YEAR CLASS.

Two regular examinations for admission to the First-Year Class are held each year,—one at the beginning of the summer vacation, and the other before the beginning of the academic year in the autumn.

First Examination.

In 1897, the *first examination* will be held on Tuesday, Thursday, Friday, and Saturday, June 29, July 1, 2, and 3.

Candidates who wish to take any of the examinations held on the first day must assemble punctually at 8 A.M. on that day. All other candidates must present themselves punctually at 8 A.M. on the second day.

The examinations will be held in the following places :—

- In *Cambridge*, in Sever Hall.
- In *Quincy*, in the rooms of the Adams Academy.
- In *Andover*, in the rooms of the Phillips Academy.
- In *Groton*, in the rooms of Groton School.
- In *Southborough*, in the rooms of St. Mark's School.
- In *Worcester*, in Curtis Hall, the Young Men's Christian Association building, Elm Street.
- In *Exeter, N. H.*, in the rooms of Phillips Exeter Academy.
- In *Concord, N. H.*, in the rooms of St. Paul's School.
- In *Portland, Me.*, in the rooms of the Portland High School.
- In *Lakeville, Conn.*, in the rooms of the Hotchkiss School.
- In *New York, N. Y.*, in the lecture-room of the Young Men's Christian Association, Twenty-third Street, corner of Fourth Avenue.
- In *Garden City, N. Y.*, in the rooms of St. Paul's Cathedral School.
- In *Albany, N. Y.*, in the rooms of the Young Men's Christian Association.
- In *Buffalo, N. Y.*, in the High School building, corner of Court and Franklin Streets.
- In *Philadelphia, Pa.*, in the rooms of the Young Men's Christian Association building, corner of Fifteenth and Chestnut Streets.
- In *Lawrenceville, N. J.*, in the rooms of the Lawrenceville School.
- In *Washington, D. C.*, in the rooms of the Young Men's Christian Association.
- In *Cleveland, O.*, in the Central High School building.
- In *Cincinnati, O.*, in the rooms of the Young Men's Christian Association.
- In *Chicago, Ill.*, in the Assembly Room of the Board of Education.
- In *Minneapolis, Minn.*, in the Lecture-room of the Public Library building.
- In *St. Louis, Mo.*, in the Board of Education building, corner of Ninth and Locust Streets.
- In *Omaha, Neb.*, in the rooms of the Young Men's Christian Association.
- In *Denver, Col.*, in the rooms of the Denver High School (District No. 1), corner of Nineteenth and Stout Streets.
- In *San Francisco, Cal.*, in the rooms of the Mechanics' Institute, 31 Post Street.
- In *Belmont, Cal.*, in the rooms of the Belmont School.
- In *Portland, Oregon*, in the Portland Library.
- In *Kansas City, Mo.*, in Association Building, 810 Wyandotte St.
- In *Bonn, Germany*, at the Hotel Kley.
- In *Tokyo, Japan*.

The School will ordinarily conduct the admission examinations in June in any school or city where the number of candidates for examination, Preliminary or Final, shall be not less than ten; provided that the school or city be not within easy reach of one of the regular places of examination. Applications for examinations in June, in schools or cities not named above, should be made to the Corresponding Secretary of Harvard University as early as the 1st of April.

Notice Required.

For the notice and the fees required of candidates examined in any place other than Cambridge, see p. 32.

Second Examination.

The *second examination* will be held in *Cambridge only*, on Wednesday, Thursday, Friday, and Saturday, September 22, 23, 24, and 25.

All candidates must present themselves punctually at 8 A.M. on the *first* day of the examination.

ORDER OF EXAMINATIONS.

Tuesday, June 29, and Wednesday, September 22.

8 A.M. Candidates offering Advanced German, Advanced Chemistry, Advanced Physics, Advanced Algebra, or Analytic Geometry meet the officer in charge of the examination.

9-11. Advanced German.

11½-12½. Advanced Chemistry (written examination).

12½-1½. Advanced Algebra.

2-3. Analytic Geometry.

3-4. Advanced Physics (written examination).

Thursday, July 1, and Thursday, September 23.

8 A.M. Candidates meet the officer in charge of the examinations.

Friday, July 2, and Friday, September 24.

8-9. Elem. Physics. 11½-12½. History.

9½-10½. Plane Geometry. 1½-3½. English.

10½-11½. Algebra.

Saturday, July 3, and Saturday, September 25.

8-10. Advanced French. 1½-2½. Elem. French (French A).

10½-11½. Log. and Trigonometry. 2½-3½. Elem. German (German A).

3½-4½. Solid Geometry.

LABORATORY EXAMINATIONS.

The stated time for the laboratory examination in Elementary Experimental Physics is Thursday, Friday, and Saturday of the examination periods; in Advanced Physics and Chemistry, Tuesday of the June period and Wednesday of the September period. On these days examinations are held in Cambridge only, and appointments for them will be made when the candidates meet the officer in charge of the examination.

In June, classes from schools near Cambridge may, by special arrangement, take the laboratory examinations in Physics and Chemistry on earlier days.

Laboratory examinations in Physics and Chemistry, but only for those who have previously passed the written examination and received a provisional mark (see p. 37), will be held as follows: Elementary and Advanced Physics on Wednesday, September 30, at 2 P.M. in the Jefferson Physical Laboratory, (these examinations, however, may, if desired, be taken at the stated times as given above); Advanced Chemistry on Wednesday, September 30, at 2 P.M. in Boylston Hall.

ADMISSION TO ADVANCED STANDING.

A candidate may be admitted to advanced standing either by passing examinations in all the studies already pursued by the class for which he offers himself, in addition to the entrance examinations; or from another scientific school or college upon such conditions as the Administrative Board may deem equitable in each case, regard being had to the applicant's previous course of study, and to the evidence of proficiency exhibited by him.

The successful study of any subject in Harvard College will be taken as an equivalent for the same subject in the Scientific School; but no Scientific School degree will be given to a graduate of the College without at least one full year's work in the School.

ADMISSION OF SPECIAL STUDENTS.

The courses of study in the Scientific School are open to persons who satisfy the Administrative Board of the School of their fitness to pursue the particular courses they elect, although they have not passed the usual examinations for admission. These students are known as Special Scientific Students; they are members of the School from the time of their admission, but are not candidates for the degrees given by the School.

Special Students are subject to all the regulations of the School. A report of their work is sent to their parents or guardians at the end of the year.

The Administrative Board reserves the right to deprive any Special Student of his privileges at any time, if he abuse or fail to use them.

A certificate of proficiency will be given, if desired, to any Special Student who has faithfully pursued his chosen subjects throughout a year and attained a grade not lower than Grade *B* therein.

For other regulations governing Special Students see page 45.

FORM OF APPLICATION.

Persons who wish to enter the School with Advanced Standing or as Special Students will be furnished with printed forms of application by the Secretary of the School. The form must be filled out and returned to the Secretary before the application will be considered by the Administrative Board of the School.

REGULATIONS.

PETITIONS.

1. Every request from a student to the Administrative Board should be made in writing, and should be addressed to the Dean of the School.

REGISTRATION AND RESIDENCE.

2. Every student is required to present himself for registration not later than Thursday, the first day of the academic year, between 9 A.M. and 1 P.M., at a place announced on the bulletin boards. He is further required to register not later than 12 M. on the first week-day after the Christmas recess and the first week-day after the April recess.

3. Continuous residence at the University is required during term-time. No interruption of residence is permissible, except for satisfactory reasons stated to the Secretary (orally, if possible) before the student leaves Cambridge. The student who has been absent must also report in person to the Secretary immediately on his return.

SCHOOL EXERCISES.

4. A student prevented by illness or other cause from attending School exercises for a day or more must send notice to the Secretary without delay. Immediately on his return to duty, he must make, at the Secretary's office, a specific statement of the cause of his absence; and, if his explanation is satisfactory, his absence will be excused.

5. A student who fails to give an instructor a theme, forensic, or other written exercises at the appointed time will get no credit for it, unless he satisfies the Secretary that the delay was caused by serious illness or other unavoidable hindrance.

6. A student who has neglected the work of any course may be excluded from the course by the instructor with the approval of the Dean.

ENROLMENT.

7. Every student is required to hand to the officer with whom he registers at the beginning of the academic year a list of his studies *for the whole year*. This list must be written on a card provided for the purpose, and must be signed by his Adviser.

At the same time and on the same card, every student is required to enroll himself in each of his studies which begin in the first half-year, whether prescribed or elective.

8. It is of the utmost importance that the student should have fully considered and decided upon his plan of study before the first day of the year, as changes, either additions to, or subtractions from the lists then handed in, are not allowed except for causes which could not have been foreseen. Changes may be made only with the approval of the Adviser and permission of the Dean, to whom application must be made in writing (on a blank form to be obtained at the office) with a full statement of reasons.

9. A student who has obtained leave to change his studies must enroll with the Secretary immediately upon receiving notice that the change has been permitted.

The exercises are held at the hours set down in the Announcement and at places to be announced on the bulletin boards.

EXTRA STUDIES.

10. A student who wishes, without assuming all the responsibilities of a regular study, to attend the instruction of any course, may do so on obtaining leave of the instructor; but no record will be kept of his attendance, and he will receive no credit in the course.

ANTICIPATORY EXAMINATIONS.

11. Students who have passed the examination at admission in any advanced studies or in any study required in the school will be given credit for the courses so passed, and may substitute for them other courses, with the approval of the Administrative Board.

DEFICIENCIES.

12. A candidate may be admitted in spite of deficiencies in some of the admission subjects; but no candidate so admitted will be advanced to Third-Year standing in the School until he has made good such deficiencies to the satisfaction of the Administrative Board.

The exact number of deficiencies with which a candidate may be admitted cannot be named in advance, since each case is considered on its merits.

13. Students who have not received official notice of having passed all of the admission examinations in Mathematics must obtain the signature of the instructor of the First-Year Mathematics before registration in order to be allowed to enroll in the mathematical courses.

14. No student in the Engineering courses will be advanced to Second-Year standing until all his admission deficiencies in Mathematics are made good to the satisfaction of the Administrative Board.

15. Students of Mechanical and Electrical Engineering of the First-Year who have any admission condition, and those of the Second-Year who have either condition or deficiency will not be allowed to take the work-shop courses at the time appointed on the schedule, but will be required to take them during the following summer.

PROMOTION.

16. In order to be promoted to a higher class at the end of a school year, a student must have attained in that year grade *C* or higher in at least one half of his required work, and must not have an aggregate deficiency of more than two courses.

17. A student who has failed in any course of prescribed study must make up the deficiency by taking the same course in some following year, and he is barred from dependent courses until such deficiency is made good.

18. A student who has failed of promotion under the operation of rule 15 is thereby placed on probation unless he satisfies the Administrative Board that his failure was not due to neglect.

19. To obtain credit in a course of study, or to count the course towards fulfilment of the requirements for a degree, the student must have attended both the mid-year and the final examinations. This rule applies to all students, including suspended students and students on leave of absence.

SPECIAL STUDENTS.

20. At the beginning of each year special students must submit their choice of studies for approval. They will be required to take each year four full courses selected from among the following: Courses in Mathematics, Engineering, Physics, Chemistry, Geology, Botany or Zoology, and any courses in other departments which are prescribed in the several departments of study for the degree of S.B.

21. At least one half of the work of each special student must be taken from the regular programme of the department of study in which he registers.

22. Candidates who cannot otherwise show that they are competent to pursue subjects which are protected by entrance examinations, must pass satisfactory tests before entering these courses.

23. Exceptional cases may be referred to the Administrative Board by petition.

EXAMINATIONS.

24. A student who has been absent from a mid-year examination, and has satisfied the Secretary that his absence was caused by serious illness or other unavoidable hindrance, is entitled to a second and last opportunity of passing the examination at some time during the period of the final examinations, provided he make written request for such examination before May 1.

25. A student who, having passed the mid-year examination in any course of study, has been absent from the final examination, and has satisfied the Secretary that his absence was caused by serious illness or other unavoidable hindrance, is entitled to a second and last opportunity of passing the examination at some time during the first fortnight of the ensuing academic year, provided he make written request for such examination before September 10.

26. No student is permitted to take any books or papers into an examination room except by express direction of the instructor. No communication is permitted between students in an examination room on any subject whatever.

27. If a student is tardy at an examination, he may not be admitted to it, and may be reported as absent.

GOOD ORDER.

28. No student shall lodge or board in any house disapproved by the Regent, or change his lodging without giving immediate notice to the Secretary.

29. No student shall refuse to give his name to an officer of the University. Every society of students shall give the Regent, at his request, a complete list of its officers and members.

30. No dramatic or musical society shall take part in an entertainment for money or out of the limits of Old Cambridge without permission of the Faculty Committee on Dramatic and Musical Entertainments.

DISCIPLINE.

31. Neglect of School work and offences against law and order will be dealt with as the Faculty or the Administrative Board shall determine. Discipline may be enforced by Admonition, Probation, Suspension, Dismissal, or Expulsion.

Admonition is warning notice to parent or guardian.

Probation means serious danger of separation from the University. A student on probation is not allowed to compete for scholarships, prizes, or honors, or to take part—whether with students or with other persons—in any public theatrical or musical performance or in any public athletic

contest; he cannot be restored to full standing without a special vote of the Administrative Board, and he cannot be recommended for a degree; he may be required to put himself under the direction of a private tutor approved by the Dean, or to report daily to an officer of the University, or to do both; and at any time, by vote of the Administrative Board, his probation may be closed and his connection with the University ended.

Suspension is temporary separation from the University, and may involve residence in a specified place and performance of specified tasks. A suspended student is not allowed to reside in Cambridge without the permission of the Administrative Board, or to visit Cambridge without the permission of the Dean, excepting at the period of the mid-year and final examinations. A suspended student is not allowed to take part in the public performances or games of any University association.

Dismissal closes a student's connection with the University, without necessarily precluding his return.

Expulsion is final separation from the University.

FOUR YEARS COURSES OF STUDY.

The courses are selected mainly from the Courses of Instruction provided by the Faculty of Arts and Sciences and described at length in the University Catalogue, under the headings which are here given in the brackets.

The numbers and letters prefixed to the several courses are intended to be permanent, and no attempt is made to arrange them in a regular or complete series.

The Roman numeral in parentheses appended to each course indicates the examination group to which the course belongs. No student will be examined in two courses which are in the same group, with the exception of half-courses which are not given in the same half-year and of the following: the courses having the same letter or number in Latin and Greek Composition; Physics *B* and Chemistry 1; French 8 and German *A* or *B*; Philosophy 6 and 18; Mathematics 19 and 24.

COURSES OF FOUR YEARS IN ENGINEERING.

The courses of instruction are planned to extend over a period of four or five years, and to prepare students to enter any one of the four following branches of the profession:

- I. Civil and Topographical Engineering.
- II. Electrical Engineering.
- III. Mechanical Engineering.

The courses, as laid down, are designed to combine a good general education with the training for a profession; and, for this reason, considerable instruction is given in English, Modern Languages and Natural Science.

Inasmuch as the student cannot expect to become an experienced engineer in four years of undergraduate work, the aim of the School is to give him a thorough mental training, — to teach him to observe, to think and to deduce, rather than to try to fill his memory with matters of mere technical routine which can better be acquired after leaving school. The underlying principles of the professional subjects receive special and constant attention, and free use is made of the laboratory to make clear the applications of those principles. Abundant facilities are offered to graduate students who wish to conduct researches in connection with Materials, Hydraulics, Steam, Electricity, and the Transmission of Power. Such graduates have also opportunities for advanced study in Mathematical Physics.

The field work in Surveying and Railroad Engineering is given during the summer, and the workshop courses may be taken during the summer if a sufficient number of students desire to take the work at that time.

The course in Civil Engineering includes Topographical, Sanitary, Hydraulic, Railroad and Bridge Engineering.

The course in Mechanical Engineering covers the principles relating to the design, construction and operation of all kinds of machinery and machinery plants.

The course in Electrical Engineering fits men to undertake problems which may arise in connection with the use of electricity.

The work of the first year is nearly the same in each of the three divisions, while that of subsequent years tends gradually towards specialization, care being taken, however, that important general subjects are not overlooked. Most of the subjects given in the School are necessarily arranged in sequence, and students are required to make satisfactory records at each stage of their progress in order to obtain further advancement. As there are many sequences of this kind, the student will do well to read the notes following the descriptions of the several subjects on pages 88 *et seq.*

Students receive credit for all advanced studies passed at the entrance examination. It will be found advantageous to prepare in the mathematics of the first year before entering the School.

Admission conditions in Mathematics must be made good at the end of the first year, and admission conditions in other subjects by the end of the second year.

Summer Courses.

The courses in Surveying and Railroad Engineering are continued for five weeks into the summers of the first and second years. This is required work. It gives the student practice in the field in making actual surveys, the entire time being taken up in practical methods. Certain tracts of land bordering on the coast are surveyed and topographical maps are made to scale. Several miles of railroad are projected and surveyed and the drawings and estimates prepared for the construction of the road.

The workshop courses may be taken in the summer at the close of the first and second years by classes made up immediately after the final examinations. All students are advised to take this work in the summer, when the time can be given entirely to it, instead of during the school year.

The classes are arranged in sections, and from six to seven hours daily for five weeks will enable a student to complete two courses.

Students of Mechanical and Electrical Engineering of the First-Year who have any admission condition and those of the Second-Year who have either condition or deficiency will not be allowed to take the workshop courses at the time set down in the schedule, but will be required to take them during the following summer.

Method of Instruction.

The method of instruction is that of lectures and conferences, supplemented by recitations and laboratory work. As will be seen, laboratory practice with the testing machine, steam engine, dynamo, motor, power and hand tools and other machines is given at certain stages of instruction. Field-work with surveying and geodetic instruments is made a prominent feature of the course. Visits of inspection and observation are made to engineering works in process of construction and operation.

Lectures are given before the Harvard Engineering Society at intervals during the year by engineers engaged in the active practice of their professions. These lectures are open to all students of Engineering.

The aim of the Mathematical courses is, so far as possible, to present the essentials of the various subjects from the point of view of the student of Applied Mathematics. Instruction is given by lectures, by assigned reading, by blackboard drill, and by individual conferences. Written recitations occupying a part or the whole of the hour are given frequently. Special meetings of sections of the classes are held when desirable, for the purpose of guiding students in their study of the more difficult problems.

Civil and Topographical Engineering.

The student's attention is called to the requirement of five weeks' work in the field at the end of the first and second year; this work is a continuation of the courses in surveying and railroad engineering.

Those who pass the admission examination in French will be required to take one year of French and one year of German. Those who pass the admission examination in German will be required to take two years of French.

Students who complete this course, pass the required examinations and present a satisfactory thesis will receive the degree of Bachelor of Science in Civil and Topographical Engineering.

FIRST YEAR.

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Mechanical Drawing.—Descriptive Geometry (Engineering 3a). Messrs. MOSES and TILDEN.

Mon., at 1.30; draughting, Mon., Fri., 1.30-4.30. (XIII)

Land Surveying (Engineering 4a). Messrs. TURNER and HOPKINS.

Tu., Th., 1.30-4.30. (XIV)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON, and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary French (French A). Messrs. WRIGHT and LA MESLEÉ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

Or Advanced French (French 1b). Messrs. BABBITT and FORD.

Mon., Wed., Fri., at 9. (IX)

SECOND YEAR.

Solid Analytic Geometry, Differential and Integral Calculus (Engineering 1c). Mr. LOVE.

Tu., Th., Sat., 11, and an additional hour at the pleasure of the instructor. (IX)

Structural and Machine Drawing (Engineering 3c). Mr. MOSES.

Mon., at 11; draughting, six hours a week. First half-year. (III)

Practical Astronomy (Engineering 2b). Dr. WILLSON.

Mon., Wed., Fri., at 12, and laboratory work. Second half-year. (IV)

Geodesy (Engineering 4c). Messrs. TURNER and HOPKINS.

Mon., Fri., 1.30-4.30. Second half-year. (XIII)

Railroad Engineering (Engineering 4d). Mr. TURNER.

Mon., Fri., 1.30-4.30. First half-year. (XIII)

General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; and laboratory work, two hours a week. (VIII)

English Composition (English BC.) Messrs. HURLBUT, HALL and HAPGOOD.

Wed., at 1.30. (XIII)

Advanced French (French 1b). Messrs. BABBITT and FORD.

Mon., Wed., Fri., at 9. (IX)

Or Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

THIRD YEAR.

Analytic and Applied Mechanics (Engineering 5a). Professor HOLLIS and Asst. Professor JOHNSON.

Tu., Th., Sat., at 11. (IX)

Hydraulics (Engineering 6a). Messrs. TURNER and HOPKINS.

Mon., Wed., Fri., at 9. Second half-year. (I)

Experimental Methods (Engineering 13a). Mr. L. S. MARKS.

Fri., at 11; laboratory work, three hours a week. (III)

Machinery and Boilers (Engineering 11a). Messrs. MARKS and BURKE.

Tu., Th., Sat., at 9. (VII)

Masonry and Foundations (Engineering 8a). Asst. Professor JOHNSON.

Tu., Th., Sat., at 10. Second half-year. (VIII)

Metallurgy (Engineering 18a). Mr. BURKE.
Tu., Th., Sat., at 12. First half-year. (X)

Common Roads (Engineering 4e). Mr. MCCLINTOCK.
Tu., Th., Sat., at 9. Second half-year. (VII)

Physiography (Geography 2). Professor DAVIS.
Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu. between 9 and 12, and additional laboratory and field hours. First half-year. (II)

And Meteorology (Meteorology 1). Mr. WARD.
Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu. between 9 and 12, and additional laboratory hours. Second half-year. (II)

Or Elementary Geology (Geology 4). Professor SHALE and Messrs. J. B. WOODWORTH and WOODMAN.
Wed., Fri., (and occasionally Mon.) at 12. (IV)

Optional.

Calculus (second course) (Engineering 1f). Mr. LOVE.
Mon., Wed., Fri., at 12. First half-year. (IV)

FOURTH YEAR.

Bridges and Buildings (Engineering 7a). Asst. Professor JOHNSON.
Mon., Wed., Fri., 1.30-4.30. (V, VI, and XIII)

Resistance of Materials (Engineering 5c). Professor HOLLIS.
Mon., Wed., Fri., at 11; laboratory work, three hours a week. First half-year. (III)

Experimental Hydraulics (Engineering 18d). Mr. TURNER.
Th., 1.30-4.30. (XIV)

Canals, Rivers, and Irrigation (Engineering 6d). Mr. TURNER.
Tu., Th., Sat., at 9. First half-year. (VII)

Sanitary Engineering (Engineering 6c). Mr. RICE.
Tu., Th., Sat., at 9. Second half-year. (VII)

Industrial Applications of Electricity (Engineering 16a). Asst. Professor ADAMS.
Tu., Th., 10; laboratory work, three hours a week. First half-year. (VIII)

Contracts and Specifications (Engineering 22). Mr. ARCHER.
Fri., at 9. Second half-year. (I)

Economics of Machinery (Engineering 21). Professor HOLLIS.
Sat., 10-12. (VIII)

Preparation of Thesis.

One course, or two half-courses, must be chosen for the fourth year in addition to those required above, the subject to be selected from the Elective Pamphlet with the approval of the Engineering Department.

Electrical Engineering.

An additional year is provided for those who wish to make an extended study of the mathematical theory of Electricity. The student's attention is called to the shopwork, a large part of which may be satisfied by five weeks' Summer work at the end of each of the first two years. Those who pass the admission examination in German will be required to take one year of French and one year of German. Those who pass the admission examination in French will be required to take two years of German.

Students who complete this course and pass the required examinations and present a satisfactory thesis will receive the degree of Bachelor of Science in Electrical Engineering.

FIRST YEAR.

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Mechanical Drawing.—Descriptive Geometry (Engineering 3a). Messrs.

MOSES and TILDEN.

Mon., at 1.30; draughting, Mon., Fri., 1.30–4.30. (XIII)

Shopwork.—Use of Tools (Engineering 10a). Mr. BURKE.

Lectures and laboratory work, six hours a week for a half-year.

(XIV)

Shopwork.—Blacksmithing (Engineering 10b). Mr. BURKE.

Lectures and laboratory work, six hours a week for a half-year.

(XIV)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30–3.30, or Wed.,

Fri., 2.30–4.30. (IV)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

SECOND YEAR.

Solid Analytic Geometry. — Differential and Integral Calculus (Engineering 1c). Mr. LOVE.

Tu., Th., Sat., at 11, and an additional hour at the pleasure of the instructor. (IX)

Structural and Machine Drawing (Engineering 3c). Mr. MOSES.

Mon., at 11; draughting, six hours a week. First half-year. (III)

Mechanism (Engineering 3d). Mr. MOSES.

Mon., Wed., at 11; draughting, four hours a week. Second half-year. (III)

Shopwork. — Pattern Making and Foundry (Engineering 10c and 10d), Mr. BURKE.

Lectures and laboratory work, *six hours a week for a half-year.*

(XIII)

Shopwork. — Machine Tools (Engineering 10e). Mr. BURKE.

Lectures and laboratory work, *six to nine hours a week for a half-year.* (XIII)

Experimental Physics (Physics C). Asst. Professor SABINE and Mr. HILL.

Fri., at 1.30; laboratory work, one afternoon each week from 2 to 6. (XIII)

Sections for laboratory work will be arranged for *Mon., Tu., Wed., and Th., afternoons.*

Or General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

English Composition (English BC). Messrs. HURLBUT, HALL, and HAPGOOD.

Wed., at 1.30. (XIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

Or Elementary French (French A). Messrs. WRIGHT and LA MESLE.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

THIRD YEAR.

Analytic and Applied Mechanics (Engineering 5a). Professor HOLLIS and Asst. Professor JOHNSON.

Tu., Th., Sat., at 11. (IX)

Dynamo Electric Machinery.—Continuous and Alternating Currents (Engineering 16c and 16e). Asst. Professor ADAMS and Mr. WHITING.

16c. *Tu., Th., at 1.30; laboratory work, three hours a week.*
First half-year. (XIV)

16e. *Tu., Th., at 1.30; laboratory work, three hours a week.*
Second half-year. (XIV)

Machinery and Boilers (Engineering 11a). Messrs. MARKS and BURKE.

Tu., Th., Sat., at 9. (VII)

Hydraulics (Engineering 6a). Messrs. TURNER and HOPKINS.

Mon., Wed., Fri., at 9. Second half-year. (I)

Experimental Methods (Engineering 13a). Mr. MARKS.

Fri., at 11; laboratory work, three hours a week. (III)

Electrostatics, Electrokinematics, and Electromagnetism (Physics 3).

Professor B. O. PEIRCE and Mr. DUBWARD.

Tu., at 12; laboratory work, six to eight hours a week. (X)

Thermodynamics (Physics 6¹). Professor HALL.

Mon., Fri., at 9, and a third hour at the pleasure of the instructor.

First half-year. (I)

Optional.

Calculus (second course) (Engineering 1f). Mr. LOVE.

Mon., Wed., Fri., at 12. First half-year. (IV)

FOURTH YEAR.

Resistance of Materials (Engineering 5c). Professor HOLLIS.

Mon., Wed., Fri., at 11; laboratory work, three hours a week.
First half-year. (III)

Dynamo Electric Machinery (second course) (Engineering 16d and 16f).

Asst. Professor ADAMS and Mr. WHITING.

16d. *Lectures and laboratory, six hours a week. First half-year.*
(XIII)

16f. *Lectures and laboratory, six hours a week. Second half-year.*
(XIII)

Economics of Steam (Engineering 12a). Mr. MARKS.

Mon., Wed., Fri., at 9. First half-year. (I)

- Machine Design (Engineering 14a).** Mr. MOSES.
Tu., Th., 1.30-4.30. (XIV)
- Contracts and Specifications (Engineering 22).** Mr. ARCHER.
Fri., at 9. Second half-year. (I)
- Economics of Machinery (Engineering 21).** Professor HOLLIS.
Sat., 10-12. (VIII)
- Preparation of Thesis.**

One course, or two half-courses, must be chosen for the fourth year, in addition to those required above, the subject to be selected from the Elective Pamphlet with the approval of the Engineering Department. This does not apply to those who take a fifth year.

Advanced Course of Electrical Engineering.

The following advanced course is provided for those students who wish to continue their studies a year beyond the regular course. The additional year is devoted, for the most part, to the study of mathematics and the mathematical theory of electricity; but additional time is also available for advanced experimental work and for preparation of the thesis.

THIRD YEAR.

- Differential and Integral Calculus (second course) (Mathematics 5).**
 Professor BYERLY.
Mon., Wed., Fri., at 11. (III)
- Taken in addition to courses already provided in the third year.

FOURTH YEAR.

- Trigonometric Series. — Spherical Harmonics (Mathematics 10).** Professors BYERLY and B. O. PEIRCE.
Tu., Th., Sat., at 12. (X)
- Electrodynamics, Magnetism, and Electromagnetism (Physics 4).** Professor TROWBRIDGE, Asst. Professor SABINE, and Mr. BILLINGS.
Tu., Th., at 10, and laboratory work. (VIII)
- Taken in addition to courses already provided in the fourth year.

FIFTH YEAR.

- Mathematical Theory of Electrostatics and Electrokinematics (Physics 9).**
 Professor B. O. PEIRCE.
Mon., Wed., Fri., at 10. (II)
- Electrodynamics (Physics 8).** Professor TROWBRIDGE.
Laboratory work, nine hours a week.
- Practical Work and Thesis.**

Mechanical Engineering.

The student's attention is called to the shopwork, a large part of which may be satisfied by five weeks' Summer work at the end of the first and second years. Those who pass the admission examination in German are required to take one year of French and one year of German. Those who pass the admission examination in French are required to take two years of German.

Students who complete this course, pass the examinations and present a satisfactory thesis will receive the degree of Bachelor of Science in Mechanical Engineering.

FIRST YEAR.

Algebra (Engineering 1a). MESSRS. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). MESSRS. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). MESSRS. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Mechanical Drawing.—Descriptive Geometry (Engineering 3a). MESSRS. MOSES and TILDEN.

Mon., at 1.30; draughting. Mon., Fri., 1.30-4.30. (XIII)

Shopwork.—Use of Tools (Engineering 10a). MR. BURKE.

Lectures and laboratory work, six hours a week for a half-year. (XIV)

Shopwork.—Blacksmithing (Engineering 10b). MR. BURKE.

Lectures and laboratory work, six hours a week for a half-year. (XIV)

General Descriptive Chemistry (Chemistry 1). PROFESSOR JACKSON, and MESSRS. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Rhetoric and English Composition (English A). PROFESSORS A. S. HILL and BRIGGS, and MESSRS. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HAET, NOYES, LA ROSE and COTTON.

Divided in sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

SECOND YEAR.

Solid Analytic Geometry, Differential and Integral Calculus (Engineering 1c). Mr. LOVE.

Tu., Th., Sat., at 11, and an additional hour at the pleasure of the instructor. (IX)

Structural and Machine Drawing (Engineering 3c). Mr. MOSES.

Mon., at 11; draughting, six hours a week. First half-year.

(III)

Mechanism (Engineering 3d). Mr. MOSES.

Mon., Wed., at 11; draughting, four hours a week. Second half-year. (III)

Shopwork. — Pattern Making and Foundry (Engineering 10c and 10d).

Mr. BURKE.

Lectures and laboratory work, six hours a week for a half-year.

(XIII)

Shopwork. — Machine Tools (Engineering 10e). Mr. BURKE.

Lectures and laboratory work, six to nine hours a week for a half-year. (XIII)

General Descriptive Physics (Physics 1). Professor HALL, and Mr. McELFRESH.

Tu., Sat., at 10; and laboratory work, two hours a week. (VIII)

English Composition (English BC). Messrs. HURLBUT, HALL, and HAPGOOD.

Wed., at 1.30.

(XIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9.

(VII)

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEÉ.

Mon., Wed., Fri., at 9.

(XII)

Required of students who did not offer French for admission.

THIRD YEAR.

Analytic and Applied Mechanics (Engineering 5a). Professor HOLLIS and Asst. Professor JOHNSON.

Tu., Th., Sat., at 11.

(IX)

Machinery and Boilers (Engineering 11a). Messrs. MARKS and BURKE.

Tu., Th., Sat., at 9.

(VII)

Steam Engines and Boilers. — Details (Engineering 11b). **Mr. MARKS.**
Mon., Wed., Fri., at 11. Second half-year. (III)

Hydraulics (Engineering 6a). **Messrs. TURNER and HOPKINS.**
Mon., Wed., Fri., at 9. Second half-year. (I)

Experimental Methods (Engineering 18a). **Mr. MARKS.**
Fri., at 11; laboratory work, three hours a week. (III)

Machine Design (Engineering 14a). **Mr. MOSES.**
Tu., Th., 1.30-4.30. (XIV)

Metallurgy (Engineering 18a). **Mr. BURKE.**
Tu., Th., Sat., at 12. First half-year. (X)

Thermodynamics (Physics 6¹). **Professor HALL.**
Mon., Fri., at 9. First half-year. (I)

Optional.

Calculus (second course) (Engineering 1f). **Mr. LOVE.**
Mon., Wed., Fri., at 12. First half-year. (IV)

FOURTH YEAR.

Resistance of Materials (Engineering 5c). **Professor HOLLIS.**
Mon., Wed., Fri., at 11; laboratory work, three hours a week.
First half-year. (III)

Testing Machinery and Boilers (Engineering 13b). **Mr. MARKS.**
Tu., Th., 1.30-4.30. (XIV)

Machine Design (Engineering 14b). **Professor HOLLIS.**
Mon., Fri., 1.30-4.30. (XIII)

Industrial Applications of Electricity (Engineering 16a). **Asst. Professor ADAMS.**
Tu., Th., at 10; laboratory work, three hours a week. First half-year. (VIII)

Economics of Steam (Engineering 12a). **Mr. MARKS.**
Mon., Wed., Fri., at 9. First half-year. (I)

Heating and Ventilation (Engineering 12c). **Mr. BURKE.**
Wed., Fri., at 11, and a third hour at the pleasure of the instructor. Second half-year. (III)

Contracts and Specifications (Engineering 22). **Mr. ARCHER.**
Fri., at 9. Second half-year. (I)

Economics of Machinery (Engineering 21). **Professor HOLLIS.**
Sat., 10-12. (VIII)

Preparation of Thesis.

One course, or two half-courses, must be chosen for the Fourth-Year in addition to those required above, the subject to be selected from the Elective Pamphlet with the approval of the Engineering Department.

MINING AND METALLURGY.

The aim of this course is to provide a thorough preparation for professional work in Mining and Metallurgy by instruction in Mathematics, General Engineering, Mining, Metallurgy, Chemistry, Geology and Mineralogy, as well as in selected courses in Mechanical and Electrical Engineering. The mathematical work extends over the first three years. In the First-Year are included instruction in higher Algebra, Trigonometry, and Analytic Geometry. These are followed in the Second-Year by a course in Solid Analytic Geometry and Differential and Integral Calculus, and in the Third-Year by Analytic and Applied Mechanics. The mathematical work is especially planned for Engineering students, and the solution of problems is a prominent feature in all these courses.

In general Engineering, the work in Mechanical Drawing, including Descriptive Geometry, extends over two years; in Surveying, including Geodetic, Mining, Hydrographic and Railroad Surveying, the work also extends over the same period, and includes also field-work for portions of two summer vacations; courses in Hydraulics and Hydraulic Motors, Machinery and Boilers, and in the Industrial Applications of Electricity each extend through a half-year. In the latter courses the resources of the engineering laboratories are fully utilized for the purposes of demonstration and experiment, and visits of inspection are made to the numerous pumping, power and hydraulic plants within easy access of the School.

The work in Mining and Metallurgy occupies a considerable portion of the student's time in the third and fourth years. In the Third-Year a half-course is devoted to the subjects of Prospecting, Exploring, Sampling, etc., with a general outline of mining operations, in order that the student may intelligently pursue his practical work in the following summer. Two half-courses are devoted to a systematic description of metallurgical processes. In all these courses the collections of the department of maps, specimens and photographs are constantly used. Excursions are made during the term and short vacations to points of mining and metallurgical interest. In the Fourth-Year systematic courses are given in Mining and Ore-dressing.

In Chemistry the work extends over four years. In the First-Year is placed the course in Descriptive Inorganic Chemistry, which deals with the preparation, properties and uses of the principal elements and inorganic compounds. In this course four hours' work in the laboratory each week are required during this year. It is followed in the Second-Year by Qualitative Analysis and in the Third-Year by Quantitative Analysis, each of which consists chiefly of laboratory work for at least nine hours a week throughout the year. These three courses are given in the thoroughly

equipped laboratories of Boylston Hall. In the Fourth-Year the chemical work consists of practice in the analysis of ores, metals, slags, fuels, and refractory materials, and also includes fire-essaying. The main object of this course is to teach the student to work rapidly, as well as accurately.

The work in Geology and Mineralogy begins in the Second-Year with the elementary courses in these subjects. The courses in Geology include both a systematic outline of the science, and also laboratory study of illustrative specimens, photographs, maps, models, etc., with a considerable amount of practical work in the field. In Mineralogy, besides the descriptive lectures, six hours a week throughout the year are devoted to the determination of minerals by their crystal-form and other physical properties, and by blow-pipe and chemical tests. In the Third-Year the geological work consists in the study of ore-deposits, in which the more important occurrences of the ores of the principal metals are described in their geographical and economic relations. A large collection of maps, specimens, and photographs are studied in connection with this course. In the Fourth-Year Economical Geology is continued in reference to the non-metalliferous minerals; full courses also are given in Petrography, with laboratory work; in independent geological field-work, and in writing reports.

Supplementary to the instruction given during term-time at the University, the student is required to pursue, in each of the three summer vacations occurring during his residence, a systematic plan of field-work, under the guidance of the teachers of the School. In the first summer the student's time will be devoted to general surveying, in order that he may become expert in the use of instruments, and able to work independently. In the second summer the field-work for three or four weeks will consist of practice in mine-surveying, and in plotting the notes of such surveys. The student will then give an additional six weeks to geological field-study, during which time he should acquire a general knowledge of sedimentary and igneous rocks, and of their structural features.

In the third summer the student is required to spend from eight to ten weeks in one or more mining districts. His work will include an investigation into the geological relations and occurrence of the mineral deposits of the district, and the systems of mining by which they are exploited: a detailed description and criticism will be required of the methods of mining which are there exhibited, including the details of stopping, underground transportation, hoisting, pumping, treatment of the ores, etc. In this work the student will be required to take extended notes, and to prepare a written report at the end of the season.

Persons who faithfully pursue these courses should be qualified at graduation to begin the practice of their profession. They should be

particularly well prepared in general and applied geology, and in chemistry.

The examination for admission are the same as those required for the other courses in the School. Candidates for admission are, however, advised to offer both French and German, and Experimental Physics.

Students in Harvard College, who intend after graduation to take this course, are advised, as far as possible, to anticipate the elementary work as above noted in Mathematics, Engineering, Geology, and Chemistry.

Persons who satisfactorily complete this course and present an acceptable thesis, receive the degree of Bachelor of Science in Mining and Metallurgy.

FIRST YEAR.

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Mechanical Drawing, Descriptive Geometry (Engineering 8a.) Messrs.

MOSES and TILDEN.

Mon., at 1.30; draughting, Mon., Fri., 1.30-4.30. (XIII)

Land Surveying (Engineering 4a). Messrs. TURNER and HOPKINS.

Tu., Th., 1.30-4.30. (XIV)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON, and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEÈ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

SECOND YEAR.

Solid Analytic Geometry, Differential and Integral Calculus (Engineering 1c). Mr. LOVE.

Tu., Th., Sat., at 11, and an additional hour at the pleasure of the instructor. (IX)

Geodesy (Engineering 4c). Messrs. TURNER and HOPKINS.

Mon., Fri., 1.30-4.30. Second half-year. (XIII)

Railroad Engineering (Engineering 4d). Mr. TURNER.

Mon., Fri., 1.30-4.30. First half-year. (XIII)

General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

Qualitative Analysis (Chemistry 8). Professor H. B. HILL, and Messrs. SYLVESTER, SOCH, HOLMES, and DOW.

Mon., Wed., Fri., at 11; laboratory work, nine hours a week. (III)

Mineralogy (Mineralogy 2). Professor WOLFF, Dr. PALACHE, and Dr. RANSOME.

Mon., Wed., Fri., at 10; laboratory work, six hours a week. (II)

Elementary Geology (Geology 4). Professor SHALER, and Messrs. J. B. WOODWORTH, and WOODMAN.

Wed., Fri., (and occasionally Mon.) at 12. (IV)

Field and Laboratory Geology (Geology 5). Messrs. J. B. WOODWORTH and WOODMAN.

Laboratory work with occasional lectures (*two hours, twice a week, in February and March*); field work (*one half day a week*) and laboratory work (*in April and May*).

English Composition (English BC). Messrs. HURLBUT, T. HALL, and HARGOOD.

Wed., at 1.30. (XIII)

THIRD YEAR.

Prospecting and Exploring (Mining 1). Asst. Professor SMYTH.

Tu., Th., Sat., at 12. Second half-year. (X)

Metallurgy of iron and steel, copper and nickel (Metallurgy 2). Mr. FORSYTHE.

Mon., Wed., Fri., at 12. First half-year. (IV)

Metallurgy of lead, zinc, gold, silver and the minor metals (Metallurgy 8). Mr. FORSYTHE.

Mon., Wed., Fri., at 12. Second half-year. (IV)

Mining Geology (Geology 10). Asst. Professor SMYTH.

Tu., Th., Sat., at 10. (VIII)

Analytic and Applied Mechanics (Engineering 5a). Professor HOLLIS and Asst. Professor JOHNSON.

Tu., Th., Sat., at 11. (IX)

Hydraulics (Engineering 6a), Messrs. TURNER and HOPKINS.

Mon., Wed., Fri., at 9. Second half-year. (I)

Machinery and Boilers (Engineering 11a). Messrs. MARKS and BURKE.

Tu., Th., Sat., at 9. (VII)

Structural and Machine Drawing (Engineering 3c). Mr. MOSES.

Mon., at 11; draughting, six hours a week. First half-year. (III)

Quantitative Analysis (Chemistry 4). Asst. Professor RICHARDS and Mr. BAXTER.

Mon., Wed., Fri., at 3.30; laboratory work, nine hours a week. (VI)

FOURTH YEAR.

Metal and Coal Mining (Mining 5). Asst. Professor SMYTH.

Mon., Wed., Fri., at 10. (II)

Metallurgical Chemistry (Mining 6). Mr. FORSYTHE.

Mon., Wed., Fri., at 2.30, with additional laboratory hours. (V)

Economical Geology (Geology 18). Professor SHALER and Asst. Professor SMYTH.

Wed., Fri. (and at the pleasure of the instructor), Mon., at 4.30. (III)

Geological Investigation in the Field and Laboratory (Geology 22b). Professor SHALER and other instructors.

Petrography (Petrography 12). Professor WOLFF and Dr. RANSOME.

Tu., Th., at 11, and an occasional third hour, with additional laboratory hours. (IX)

Industrial Applications of Electricity (Engineering 16a). Asst. Professor ADAMS.

Tu., Th., at 10; laboratory work, three hours a week. First half-year. (VIII)

ARCHITECTURE.

The following schedule sets forth the studies required of those persons who are candidates for the degree of S.B. in Architecture. By anticipating any of these subjects at the admission examination or by passing in the equivalent course in the Summer School, students gain additional time to devote to the strictly professional studies. The course is arranged to be completed in four years, but students are advised to take five years unless they enter the school very well prepared.

Candidates for admission who intend pursuing this course are advised to offer the History of Greece and Rome in the examination for admission. It is desirable that should have attained some proficiency in free-hand drawing before entering.

After 1897 candidates for admission to the School intending to pursue the course in Architecture will be required to pass in both the History of Greece and Rome and the History of the United States and England, and also in Freehand Drawing in addition to the other requirements for admission. In Freehand Drawing ability to represent simple objects accurately by means of firm lines will be expected. Accuracy of delineation, correctness of proportion, and good quality of line is desired rather than any attempt at elaboration. The ideal should be to express as much as possible in the fewest lines.

Students will receive credit for all advanced studies passed at the admission examination. It will be found advantageous to prepare in both French and German before entering.

Students who complete this course and present a satisfactory thesis will receive the degree of S.B. in Architecture.

The department of Architecture has the great advantage of being closely allied to the department of Fine Arts of Harvard College, and, through the intimate connection of the Lawrence Scientific School with the Academic department (both of which are united under the Faculty of Arts and Sciences), of being able to draw upon the College courses as far as may be desirable. On the other hand the Scientific School itself affords the solid basis of practical training upon which the study of architecture as a profession must rest.

The instruction offered in this department is intended to afford the preliminary technical training required for the practice of Architecture. As all such school training must be supplemented by practical experience in an architect's office, students are advised during their period of study to devote a portion of their summer vacation to that work. In grouping the courses it has been recognized that Architecture is essentially a Fine Art, the practice of which must be based on a thorough knowledge of Construction. Great stress has therefore been laid on continued practice in design and drawing and thorough instruction in the history and principles of the Fine Art of Architecture and the arts allied with it. Such knowledge as can be acquired better and more rapidly by actual office experience will only be touched upon in a general way in order to leave more time for subjects which can be adequately taught only in an archi-

tectural school. The course is so arranged that professional studies begin in the First-Year and are continued through four years. In the First-Year the History of Ancient Architecture is taken up in such a way as to give the student a familiarity with classic form which shall serve as a basis for the subsequent practice in original Design which continues through the whole of the following three years. The aim is to give students such a knowledge of the history of architecture and of the growth and meaning of architectural forms as may enable them ultimately to use precedent not blindly, but intelligently and with some freedom. The History of Architecture (with practice in drawing its various forms) is continued through the Second-Year and completed in the Third. Courses are included in the general history of the Fine Arts which enable the student to understand the relation of architecture to the other arts and the relation of the art of different periods to their social and political life, without which knowledge the architect is not likely to use the forms of his art in an intelligent and scholarly manner.

With regard to Construction, a thorough and broad general knowledge of principles and their application to modern work will be insisted upon rather than a minute consideration of constructive details. So much of Mathematics is taught as is necessary to this knowledge and to the exigencies of actual office practice. The mathematics required is completed in the First-Year. In the Second-Year Mechanics and Strength of Materials is taken up, and Building Construction in the Third. In the Third and Fourth years lectures will be given on Professional Practice, Heating and Ventilation and Sanitary Engineering. Students are advised to take the summer course in Surveying during some part of their course.

The latter half of the Fourth-Year is devoted to the preparation of a Thesis. The subject of this thesis must be decided upon in consultation with the instructors of the department at the beginning of the year. The thesis may consist of either (1) an original design for some architectural work, or (2) a series of drawings illustrative of some important architectural monument of the past. In either case it must be accompanied by a written essay considering the design, or the monument, aesthetically and in the second case historically. The essay must also consider the constructive principles involved in the design, and give calculations concerning the more important structural parts.

The department possesses a good collection of architectural casts, photographs, and drawings, which will be added to from time to time. In addition to this the collections of the Fine Arts department in the Fogg Art Museum of the University, consisting of casts, photographs, diagrams, and drawings, and the casts and photographs of Assyrian, Persian, and Roman work in the Semitic collection in the Peabody Museum, are available and are always open to students.

The University Library at Gore Hall contains a very complete collection of books on Architecture and the Fine Arts, and the department itself possesses a carefully selected working library, which is placed in a room adjoining the architectural drawing-room, where books may be freely consulted by students.

The drawing-room is open to students from 9 A.M. to 9 P.M., and an instructor will usually be present from 9 A.M. to 4 P.M.

Facilities will be given for graduate work in Architecture, and students who can do so are advised to extend their period of school training by one or more years of graduate study. The four years that has been allotted usually, in this country, to such training, is a much shorter time than is given in the great schools of art in Europe, or than might with advantage be devoted to academic training in architecture.

The courses in Architecture have been arranged primarily to meet the needs of students in the Scientific School, who are taking the technical four years' course. Certain of these courses are open also to students in the College who are fitted to profit by them.

Students in the College intending, after graduation, to take up the study of Architecture professionally, are advised to arrange their college course in such a way as to provide a foundation for their professional studies. Besides taking the courses in Fine Arts, such students are recommended to study the History of Greece and Rome, the Middle Ages, and the Renaissance. They might also, with advantage, take such courses in Classical Philology as have a bearing on the History of Art, and it is important that they should acquire a knowledge of French and German, as the best works on architecture are in these languages. Some mathematical courses should also form part of such a plan of general education intended to serve as a foundation for the subsequent technical study of architecture. The mathematics required in the four years' course in architecture might in this way be anticipated. The instructors in architecture will be glad to advise with students who intend to plan such a course.

If the college course is carefully planned with that end in view, it will be possible to graduate in architecture in three years after taking the academic degree, or even in two years, although this is not advised.

The work of the architect requires not only a technical knowledge of building processes and familiarity with architectural form, its history and use, but it demands wide intellectual sympathy, cultivated taste, and trained imagination. Such training and cultivation can most readily be obtained — or the impulse leading to it can best be given — by a carefully arranged college course. Those who intend to pursue architecture as a profession are therefore strongly advised to take, if possible, a full college course before beginning their technical studies.

FIRST YEAR.

Technical and Historical Development of the Ancient Styles, (Architecture 1a). Asst. Professor WARREN.

Mon., Fri., at 12, and a third hour at the pleasure of the instructor, and additional hours for drawing. (IV)

Architectural Drawing (Architecture 2a). Asst. Professor WARREN, and Messrs. NEWTON and FOX.

Tu., Th., 10-12, and additional hours for drawing. (VIII)

Principles of Delineation and Freehand Drawing (Fine Arts 1). Professor MOORE.

Mon., Wed., Fri., at 2.30, and additional hours for drawing. (V)

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, NOYES, HART, LA ROSE, and COTTON.

Divided in sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEÉ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

SECOND YEAR.

Freehand Drawing from Architectural Subjects (Architecture 3a). Asst. Professor WARREN and Mr. NEWTON.

Two sections. I, Mon., Wed., Fri., at 9, and three other hours; II, Tu., Th., Sat., at 9, and three other hours.

†Technical and Historical Development of the Mediaeval Styles (Architecture 1b). Asst. Professor WARREN.

Mon., Wed., at 10, and a third hour at the pleasure of the instructor. (II)

Or †Technical and Historical Development of the Renaissance and Modern Styles (Architecture 1c). Asst. Professor WARREN.

Mon., Wed., at 10, and a third hour at the pleasure of the instructor. (II)

Elementary Architectural Design (Architecture 4a). Asst. Professor WARREN and Mr. NEWTON.

Tu., Th., 2.30-4.30, and additional hours for drawing. (XI)

Analytic and Applied Mechanics (Engineering 5a). Professor HOLLIS and Asst. Professor JOHNSON.

Tu., Th., Sat., at 11. (IX)

English Composition (English BC).

Messrs. HURLBUT, HALL and HAPGOOD.

Wed., at 1.30. (XIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

Or Advanced French (French 1b). Messrs. BABBITT and FORD.

Mon., Wed., Fri., at 9. (IX)

THIRD YEAR.

Freehand Drawing from Architectural Subjects (Architecture 3b). Asst. Professor WARREN and Mr. NEWTON.

Mon., Wed., Fri., at 9, and three other hours. (I)

†Technical and Historical Development of the Mediaeval Styles (Architecture 1b). Asst. Professor WARREN.

Mon., Wed., at 10, and a third hour at the pleasure of the instructor. (II)

Or †Technical and Historical Development of the Renaissance and Modern Styles (Architecture 1c). Asst. Professor WARREN.

Mon., Wed., at 10, and a third hour at the pleasure of the instructor. (II)

Architectural Design (second course) (Architecture 4b). Asst. Professor WARREN and Mr. NEWTON.

Tu., Th., 2.30-4.30, and additional hours for drawing. (XI)

Masonry and Foundations (Engineering 8a). Asst. Professor JOHNSON.

Tu., Th., Sat., at 10. Second half-year. (VIII)

†Ancient and Mediaeval Art (Fine Arts 3). Professors NORTON and MOORE.

Tu., Th., Sat., at 9. (VII)

Or †Roman and Mediaeval Art (Fine Arts 4). Professor NORTON.

Tu., Th., Sat., at 9. (VII)

† These courses are given in alternate years.

†Private Life of the Greeks as illustrated by Works of Art. (Greek 10.)
Professor WHITE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 12. (X)

Or †Private Life of the Romans as illustrated by Works of Art. (Latin 10)
Professor GREENOUGH.

Tu., Th., Sat., at 12. (X)

FOURTH YEAR.

Freehand Drawing from Architectural Subjects (Architecture 3c). Asst.
Professor WARREN and Mr. NEWTON.

Daily, 9-10.

Architectural Design (advanced course) (Architecture 4c). Asst. Pro-
fessor WARREN and Mr. NEWTON.

Three times a week.

Modelling.

Once a week for two and a half or three hours.

†Ancient and Mediaeval Art (Fine Arts 3). Professors NORTON and
MOORE.

Tu., Th., Sat., at 9. (VII)

Or †Roman and Mediaeval Art (Fine Arts 4). Professor NORTON.

Tu., Th., Sat., at 9. (VII)

†Private Life of the Romans as illustrated by Works of Art. (Latin 10.)
Professor GREENOUGH.

Tu., Th., Sat., at 12. (X)

Or †Private Life of the Greeks as illustrated by Works of Art. (Greek 10.)
Professor WHITE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 12. (X)

Geology and Mineralogy of Building Stones (Petrography 3). Professor
WOLFF and an assistant.

Three lectures a week, and laboratory work. First half-year. (—)

Contracts and Specifications (Engineering 22). MR. ARCHER.

Fri., at 9. Second half-year. (I)

Thesis.

CHEMISTRY.

This course of study is intended for students preparing to become
practical chemists or teachers of the science.

Candidates who propose to register in this department must offer at their
examination for admission Experimental Physics and Chemistry.

Students who complete this course, pass the required examination and
present a satisfactory thesis, will receive the degree of Bachelor of Science
in Chemistry.

† These courses are given in alternate years.

FIRST YEAR.

General Descriptive Chemistry (Chemistry 1). Professor JACKSON and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Mechanical Drawing.—Descriptive Geometry (Engineering 3a). Messrs. MOSES and TILDEN.

Mon., at 1.30; draughting, Mon., Fri., 1.30-4.30. (XIII)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEÉ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

SECOND YEAR.

Qualitative Analysis (Chemistry 3). Professor H. B. HILL, and Messrs. SYLVESTER, SOCH, HOLMES, and DOW.

Mon., Wed., Fri., at 11; laboratory work, nine hours a week. (III)

Quantitative Analysis (Chemistry 4). Asst. Professor RICHARDS and Mr. BAXTER.

Mon., Wed., Fri., at 3.30; laboratory work, nine hours a week. (VI)

Mineralogy (Mineralogy 2). Professor WOLFF, Dr. PALACHE, and Dr. RANSOME.

Mon., Wed., Fri., at 10, and additional laboratory hours. (II)

Experimental Physics (Physics C). Asst. Professor SABINE and Mr. L. D. HILL.

Fri., at 1.30; laboratory work, one afternoon each week from 2 to 6. (XIII)

Or General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

English Composition (English BC). Messrs. HURLBUT, HALL, and HAPGOOD.

Wed., at 1.30. (XIII)

Advanced French (French 1b). Messrs. BABBITT and FORD.

Mon., Wed., Fri., at 9. (IX)

THIRD YEAR.

Advanced Quantitative Analysis (Chemistry 9). Asst. Professor RICHARDS.

Mon., Wed., Fri., at 2.30; laboratory work, nine hours a week. First half-year. (V)

Gas Analysis (Chemistry 10). Asst. Professor RICHARDS.

Mon., Wed., Fri., at 2.30; laboratory work, nine hours a week. Second half-year. (V)

The Carbon Compounds (Chemistry 5). Professor H. B. HILL and Mr. SOCH.

Mon., Wed., Fri., at 9; laboratory work, six hours a week. (I)

Chemical Philosophy (Chemistry 8). Asst. Professor RICHARDS.

Tu., Th., at 12. Second half-year. (X)

Elementary Botany (Botany 1). Professor GOODALE and Mr. JONES.

Tu., Th., at 10, and a third hour at the pleasure of the instructor; laboratory work, four hours a week. Second half-year. (VIII)

Elementary Zoölogy (Zoölogy 1). Dr. DAVENPORT and Mr. LINVILLE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 10. Laboratory work, three hours a week, in five sections: I, Tu., 9-10 and 11-1; II, Tu., 1.30-4.30; III, Th., 9-10 and 11-1; IV, Th., 1.30-4.30; V, Sat., 9-10 and 11-1. First half-year. (VIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

FOURTH YEAR.

Physical Chemistry (Chemistry 6). Asst. Professor RICHARDS and Dr. COGGESHALL.

Wed., Fri., at 12; laboratory work, Mon., at 12. (IV)

Advanced study and research with preparation of a thesis (Chemistry 20), the equivalent of four courses.

GEOLOGY.

The studies in this department are designed to furnish a special training for those who wish to prepare themselves for duty in Government Geological Surveys or for teaching. The studies may, on special application to the Administrative Board of the School, be varied to meet the wants of individual students beyond the limits indicated in the programme. Those who make a good use of the opportunities afforded by the Summer Schools, held under the direction of the professors in the department, may shorten the course of study to three years. All students are required to take one of the advanced courses in Geology during one of their summer vacations. Students who design entering the School in the autumn of any year are advised to take the summer course in Elementary Geology, which is regarded as the equivalent of Geology 4.

Students who complete the above course and pass the required examinations will receive the degree of Bachelor of Science in Geology.

FIRST YEAR.

Elementary Geology (Geology 4). Professor SHALER and Messrs. J. B. WOODWORTH and WOODMAN.

Wed., Fri., and (occasionally) Mon., at 12. (IV)

Elementary Field and Laboratory Geology (Geology 5). Messrs. J. B. WOODWORTH and WOODMAN.

Laboratory work with occasional lectures (*two hours, twice a week, in February and March*); field work (*one half day a week*) and laboratory work (*in April and May*). *Second half-year.*

Meteorology (Meteorology 1). Mr. WARD.

Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu. between 9 and 12, and additional laboratory hours. Second half-year. (II)

Physiography (Geography 2). Professor DAVIS.

Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu. between 9 and 12, and additional laboratory and field hours. First half-year. (II)

General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, HART, DUFFIELD, COBB, NOYES, LA ROSE, and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLE.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

SECOND YEAR.

General Critical Geology (Geology 8). Messrs. J. B. WOODWORTH and WOODMAN.

Wed., Fri. (and occasionally Mon.), at 9, and additional hours for conference and field-work. (I)

Mineralogy (Mineralogy 2). Professor WOLFF, Dr. PALACHE, and Dr. RANSOME.

Mon., Wed., Fri., at 10; laboratory work, six hours a week. (II)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu. Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Elementary Zoölogy (Zoölogy 1). Dr. DAVENPORT and Mr. LINVILLE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 10; laboratory work, three hours a week, in five sections: I, Tu., 9-10 and 11-1; II, Tu., 1.30-4.30; III, Th., 9-10 and 11-1; IV, Th., 1.30-4.30; V, Sat., 9-10 and 11-1. First half-year. (VIII)

Elementary Botany (Botany 1.) Professor GOODALE and Mr. JONES.

Tu., Th., at 10, and a third hour at the pleasure of the instructor; laboratory work, four hours a week. Second half-year. (VIII)

English Composition (English BC). Messrs. HURLBUT, T. HALL, and HAPGOOD.

Wed., at 1.30. (XIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

THIRD YEAR.

Mining Geology (Geology 10). Asst. Professor SMYTH.

Tu., Th., Sat., at 10. (VIII)

Palaeontology (Geology 14). Professor SHALER and Dr. JACKSON.

Wed., Fri., and (occasionally) Mon., at 10. (II)

Geological field-work (Geology 22a). Mr. JAGGAR, in coöperation with Professors SHALER, DAVIS, and WOLFF, Asst. Professor SMYTH, and Mr. J. B. WOODWORTH.

Tu., at 4.30.

Petrography (Petrography 12). Professor WOLFF and Dr. RANSOME.

Tu., Th., at 11, and an occasional third hour, with additional laboratory hours. (IX)

Mechanical Drawing (Engineering 8a). Messrs. MOSES and TILDEN.

Mon., at 1.30; draughting, Mon., Fri., 1.30-4.30. (XIII)

Surveying, Plotting, and Topographical Drawing (Engineering 4a). Messrs. TURNER and HOPKINS.

Tu., Th., 1.30-4.30. (XIV)

English Composition. — Forensics (English C). Asst. Professor BAKER, and Messrs. T. HALL, PRESCOTT, and ALDEN.

Divided into sections. I, Tu., Th., at 10; II, Tu., Th., at 12; III, Tu., Th., at 1.30; IV, Tu., Th., at 3.30, and other hours to be appointed by the instructors.

FOURTH YEAR.

Historical Geology (Geology 15). Professor SHALER and Dr. JACKSON.
Mon., at 3.30. (VI)

And one of the following courses:—

Glacial Geology (Geology 16). Mr. J. B. WOODWORTH.

Wed., Fri., at 11, with additional hours for field work in October and November, and for laboratory and library work in the winter. First half-year. (III)

Geological Investigation in the Field and Laboratory (Geology 22b). Professor SHALER and other instructors in the department.

Physiography (advanced course) (Geography 20). Professor DAVIS.

Th., at 9, and a second hour at the pleasure of the instructor.

(VII)

Petrographical Research (Petrography 20b). Professor WOLFF.

Pre-Cambrian Geology of North America (Geology 27). Asst. Professor SMYTH. *Second half-year.*

A thesis embodying the results of field and laboratory work.

Professors SHALER, DAVIS, and WOLFF, Asst. Professor SMYTH, and Messrs. WOODWORTH and JAGGAR, will oversee and direct the work, in the field or library, of advanced special students in Geology.

BOTANY AND ZOOLOGY.

Students who complete this course and pass the required examinations and present a satisfactory thesis will receive the degree of Bachelor of Science in Botany and Zoölogy.

FIRST YEAR.

Elementary Botany (Botany 1). Professor GOODALE and Mr. JONES.

Tu., Th., at 10, and a third hour at the pleasure of the instructor ; laboratory work, four hours a week. Second half-year. (VIII)

Morphology of Plants (Botany 2). Asst. Professor THAXTER.

Mon., Wed., Fri., at 2.30 ; laboratory work, six hours a week. First half-year. (V)

Elementary Zoölogy (Zoölogy 1). Dr. DAVENPORT and Mr. LINVILLE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 10 ; laboratory work, three hours a week, in five sections : I, Tu., 9-10 and 11-1 ; II, Tu., 1.30-4.30 ; III, Th., 9-10 and 11-1 ; IV, Th., 1.30-4.30 ; V, Sat., 9-10 and 11-1. First half-year. (VIII)

Morphology of Animals (Zoölogy 2). Dr. PARKER and Mr. HAMAKER.

Mon., Wed., Fri., at 2.30 ; laboratory work, six hours a week. Second half-year. (V)

Elementary Geology (Geology 4). Professor SHALER and Messrs. J. B. WOODWORTH and WOODMAN.

Wed., Fri., and (occasionally) Mon., at 12. (IV)

Experimental Physics (Physics C). Asst. Professor SABINE and Mr. HILL.

Fri., at 1.30 ; laboratory work, one afternoon each week from 2 to 6. (XIII)

Sections for laboratory work will be arranged for *Mon., Tu., Wed., and Th., afternoons.*

Or General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10 ; laboratory work, two hours a week. (VIII)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10 ; II, Mon., Wed., Fri., at 11 ; III, Mon., Wed., Fri., at 12 ; IV, Tu., Th., Sat., at 10 ; V, Tu., Th., Sat., at 11 ; VI, Tu., Th., Sat., at 12. (X)*

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and
Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Tu., Wed., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEÉ.
Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

SECOND YEAR.

Physiology and Histology of Plants (Botany 8). Mr. JONES.

Tu., Th., at 2.30, and Sat., at 10; laboratory work, six hours a week. (VIII and XI)

Comparative Anatomy of Vertebrates (Zoölogy 8). Dr. G. H. PARKER
and Mr. HATHAWAY.

Tu., Th., Sat., at 9; laboratory work, six hours a week. (VII)

Physiography (Geography 2). Professor DAVIS.

*Mon., Wed., Fri., at 10, a laboratory conference of one hour on
Tu., between 9 and 10, and additional laboratory and field hours.
First half-year.* (II)

Meteorology (Meteorology 1). Mr. WARD.

*Mon., Wed., Fri., at 10, a laboratory conference of one hour on
Tu., between 9 and 12, and additional laboratory hours. Second
half-year.* (II)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON and
Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and
MERIGOLD.

*Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed.,
Fri., 2.30-4.30.* (IV)

English Composition (English BC). Messrs. HURLBUT, HALL, and HAP-
GOOD.

Wed., at 1.30. (XIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

THIRD YEAR.

Cryptogamic Botany (Botany 4). Professor FARLOW and Asst. Professor
THAXTER.

*Tu., Th., Sat., at 11; laboratory work, six hours a week. Second
half-year.* (IX)

Microscopical Anatomy (Zoölogy 4). Professor MARK and Dr. W. McM. WOODWORTH.

Mon., Wed., Fri., at 10; laboratory work, six hours a week. First half-year. (II)

Embryology of Vertebrates (Zoölogy 5). Professor MARK and Dr. W. McM. WOODWORTH.

Mon., Wed., Fri., at 10; laboratory work, six hours a week. Second half-year. (II)

This course is required of those who propose research in Zoölogy in the Fourth-Year.

Qualitative Analysis (Chemistry 3). Professor H. B. HILL, and Messrs. SYLVESTER, SOCH, HOLMES, and DAW.

Mon., Wed., Fri., at 11; laboratory work, six hours a week. (III)

General Introduction to Philosophy (Philosophy 1). Professors JAMES, PALMER, ROYCE, and Dr. RAND.

First half-year, Mon., Wed., Fri., at 2.30. Second half-year, Mon., Wed., Fri., at 12, or Mon., Wed., Fri., at 2.30. (IV and V)

Advanced French (French 1b). Messrs. BABBITT and FORD.

Mon., Wed., Fri., at 9. (IX)

FOURTH YEAR.

In the Fourth-Year the student is required to pursue some original investigation under the direction of one of the Instructors in the Department. During the first week of the year he must arrange with his special Instructor the plan of study which he proposes. At the end of the year he must present a thesis, giving the results of his studies.

The courses in which research can be conducted are the following:—

Structure, Development, Physiology, and Economics of Phanerogams (Botany 20a). Professor GOODALE.

Structure and Development of Cryptogams (Botany 20b). Professor FARLOW and Asst. Professor THAXTER.

Anatomy and Development of Animals (Zoölogy 20a). Professor MARK.

GENERAL SCIENCE.

This course of study is intended for those who wish to lay a broad foundation for subsequent special work in science. In the Fourth-Year the student pursuing this course must confine his attention to original research work or specialized work in some one department of study, and at the beginning of the Third-Year he must select the department to which he wishes to give special attention, and the courses which he

elects in the Third and Fourth years must have the approval of the committee of that department.

Students who complete this course and pass the required examinations will receive the degree of Bachelor of Science.

FIRST YEAR.

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Freehand Drawing (Fine Arts 1). Professor MOORE.

Mon., Wed., Fri., at 2.30, and additional hours for drawing. (V)

Or Mechanical Drawing (Engineering 3a). Messrs. MOSES and TILDEN.

Mon., at 1.30; draughting, Mon., Fri., 1.30-4.30. (XIII)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON, and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIETH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Mr. WRIGHT and LA MESLÉE.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

SECOND YEAR.

Solid Analytic Geometry, Differential and Integral Calculus (Engineering 1c). Mr. LOVE.

Tu., Th., Sat., at 11, and an additional hour at the pleasure of the instructor. (IX)

Experimental Physics (Physics C). Asst. Professor SABINE and Mr. HILL.

Fri., at 1.30; laboratory work, one afternoon each week from 2 to 6. (XIII)

Sections for laboratory work will be arranged for *Mon., Tu., Wed., and Th., afternoons.*

Or General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

Elementary Geology (Geology 4). Professor SHALER and Messrs. J. B. WOODWORTH and WOODMAN.

Wed., Fri., and (occasionally) Mon., at 12. (IV)

English Composition (English BC). Messrs. HURLBUT, HALL, and HAPGOOD.

Wed., at 1.30. (XIII)

Advanced German (German 1c). Dr. BIERWIRTH.

Tu., Th., Sat., at 9. (VII)

THIRD YEAR.

Qualitative Analysis (Chemistry 3). Professor H. B. HILL, and Messrs. SYLVESTER, SOCH, HOLMES, and DOW.

Mon., Wed., Fri., at 11; laboratory work, nine hours a week. (III)

Elementary Zoölogy (Zoölogy 1). Dr. DAVENPORT and Mr. LINVILLE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 10; laboratory work, three hours a week, in five sections: I, Tu., 9-10 and 11-1; II, Tu., 1.30-4.30; III, Th., 9-10 and 11-1; IV, Th., 1.30-4.30; V, Sat., 9-10 and 11-1. First half-year. (VIII)

Elementary Botany (Botany 1). Professor GOODALE and Mr. JONES.

Tu., Th., at 10, and a third hour at the pleasure of the instructor, and laboratory work. Second half-year. (VIII)

Advanced French (French 1b). Messrs. BABBITT and FORD.

Mon., Wed., Fri., at 9. (IX)

*Military Science. Lieutenant ROBINSON.

Tu., Th., Sat., at 12. (X)

Also two other courses chosen by the student with the approval of the department which he has selected for his special work.

FOURTH YEAR.

In the Fourth-Year the student will pursue a course of study which meets the approval of the committee of the department which he has already selected.

* The course in Military Science may be taken as an elective in the third or fourth year.

SCIENCE FOR TEACHERS.

This course is intended for men who wish to qualify themselves to teach science in secondary schools, or to become supervisors of science teaching in elementary schools. It prescribes courses in Mathematics, Physics, Chemistry, Botany, Zoölogy, Geology and Physical Geography, Psychology, the General Principles of Education, the History of Education, the Organization and Management of Schools and Classes, and Methods of teaching Science in Elementary and Secondary Schools, and offers a voluntary summer course in Physical Training. It also affords the student an opportunity through certain options to specialize as he proceeds through the course. Candidates for this course are required to present both Experimental Physics and Chemistry, in the admission examination, and are strongly advised to offer both French and German.

The attention of graduates of normal schools who look forward to teaching science is especially called to this course.

It will be observed that this course combines a training in science with a professional training not heretofore provided for students in the Lawrence Scientific School who are preparing to teach. This course has been established because it is believed that the growing demand for "more highly trained teachers than are now ordinarily available," should be met by suitable provision for such training in scientific schools and colleges.

The Lawrence Scientific School, while in close affiliation with the College, is, in its nature, a professional school with a distinct function. The aim of each of its courses is to enable graduates to enter at once upon their life work. Accordingly the course here offered is designed to enable men to develop an efficiency as teachers commensurate with their attainments in scholarship without the prolonged period of random experimentation which men inevitably undergo who enter on their work without professional training.

Students who complete this course and pass the required examinations will receive the degree of Bachelor of Science in Science for Teachers.

FIRST YEAR.

Algebra (Engineering 1a). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. First half-year. (II)

Trigonometry (Engineering 1b). Messrs. LOVE and ASHTON.

Tu., Th., at 10. First half-year. (VIII)

Analytic Geometry (Engineering 1d). Messrs. LOVE and ASHTON.

Mon., Wed., Fri., at 10. Second half-year. (II)

Experimental Physics (Physics C). Asst. Professor SABINE and Mr. HILL.

Fri., at 1.30; and laboratory work one afternoon each week from 2 to 6. (XIII)

Sections for laboratory work will be arranged for *Mon., Tu., Wed., and Th., afternoons.*

Logic and Psychology (Philosophy 1). Professors PALMER, JAMES, and ROYCE, and Dr. RAND.

First half-year, Mon., Wed., Fri., at 2.30.

Second half-year, Mon., Wed., Fri., at 12. (IV and V)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS and Messrs. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Divided in sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

Elementary German (German A). Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEŔ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

Students who offered both French and German at their examination for admission may take French 1b or German 1c.

Gymnastics and Athletics (voluntary).

SECOND YEAR.

History of Educational Theories and Practices (Philosophy 16). Asst. Professor HANUS.

Tu., Th., at 11. (IX)

Descriptive Chemistry (Chemistry 1). Professor JACKSON, and Messrs. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.

Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Elementary Zoölogy (Zoölogy 1). Dr. DAVENPORT and Mr. LINVILLE.

Tu., Th., and (at the pleasure of the instructor) Sat., at 10.

Laboratory work, *three hours a week*, in five sections: I, *Tu., 9-10 and 11-1*; II, *Tu., 1.30-4.30*; III, *Th., 9-10 and 11-1*; IV, *Th., 1.30-4.30*; V, *Sat., 9-10 and 11-1.* *First half-year.* (VIII)

- Elementary Botany (Botany 1).** Professor GOODALE and Mr. JONES.
Tu., Th., at 10, and a third hour at the pleasure of the instructor,
and laboratory work. Second half-year. (VIII)
- Mechanical Drawing (Engineering 3a).** Messrs. MOSES and TILDEN.
Mon., at 1.30; draughting, six hours a week, Mon., Fri., 1.30-
4.30. (XIII)
- Or Differential and Integral Calculus (Mathematics 5).** Professor BYERLY.
Mon., Wed., Fri., at 11. (III)
- English Composition (English B).** Asst. Professor WENDELL and Messrs.
 ABBOTT and COTTON.
I, Tu., Th., at 12; II, Tu., Th., at 1.30; III, Tu., Th., at 2.30.
- Or English Composition (English 22).** Messrs. GATES, ABBOTT, J. ALDEN,
 H. H. CHAMBERLIN, and NOYES.
Tu., Th., at 1.30, and conferences at hours to be announced. (XIV)
- Advanced French (French 1b).** Messrs. BABBITT and FORD.
Mon., Wed., Fri., at 9. (IX)
- Or Advanced German (German 1c).** Dr. BIERWIRTH.
Tu., Th., Sat., at 9. (VII)
- Gymnastics and Athletics (voluntary).**
- Summer Course in Physical Training (voluntary).**

THIRD YEAR.

- Introduction to Educational Theory (Philosophy 18).** Asst. Professor
 HANUS.
Mon., at 3.30. (VI)
- Elementary Geology (Geology 4).** Professor SHALER, Messrs. J. B.
 WOODWORTH and WOODMAN.
Wed., Fri., and (occasionally) Mon., at 12. (IV)
- Elementary Field and Laboratory Geology (Geology 5).** Messrs. J. B.
 WOODWORTH and WOODMAN.
*Laboratory work with occasional lectures (two hours, twice a week,
 in February and March); field-work (one half day a week) and
 laboratory work (in April and May). Second half-year.*
- Physiography (Geography 2).** Professor DAVIS.
*Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu.,
 between 9 and 12, and additional laboratory and field hours.
 First half-year. (II)*
- And Meteorology (Meteorology 1).** Mr. WARD.
*Mon., Wed., Fri., at 10, a laboratory conference of one hour, on Tu.,
 between 9 and 12, and additional laboratory hours. Second half-
 year. (II)*

Or Systematic Mineralogy (Mineralogy 2). Professor WOLFF, Dr. PALACHE, and Dr. RANSOME.

Mon., Wed., Fri., at 10, with additional laboratory hours. (II)

Or Quantitative Analysis (Chemistry 4). Asst. Professor RICHARDS and Mr. BAXTER.

Mon., Wed., Fri., at 3.30; laboratory work, nine hours a week. (VI)

Morphology of Plants (Botany 2) Asst. Professor THAXTER.

Mon., Wed., Fri., at 2.30; laboratory work, six hours a week. First half-year. (V)

And Morphology of Animals (Zoölogy 2). Dr. G. H. PARKER and Mr. HAMAKER.

Mon., Wed., Fri., at 2.30; laboratory work, six hours a week. Second half-year. (V)

Or General Descriptive Physics (Physics 1). Professor HALL and Mr. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

Qualitative Analysis (Chemistry 3). Professor H. B. HILL and Messrs. SYLVESTER, SOCH, HOLMES, and DOW.

Mon., Wed., Fri., at 11; laboratory work, nine hours a week. (III)

Argumentative Composition (English C). Asst. Professor BAKER, and Messrs. HALL, PRESCOTT, and R. M. ALDEN.

I, Tu., Th., at 10; II, Tu., Th., at 12; III, Tu., Th., at 1.30; IV, Tu., Th., at 3.30, and other hours to be appointed by the instructors.

Gymnastics and Athletics (voluntary).

Geological field-work—Summer course, Geology S2 (voluntary).

FOURTH YEAR.

Organization and Management of Schools (Philosophy 17.) Asst. Professor HANUS.

Mon., Wed., at 11. (III)

Or Pedagogical Seminary (Philosophy 20g). Asst. Professor HANUS.

Wed., at 4.30.

Graduates and other students who are properly qualified may take the Pedagogical Seminary instead of Philosophy 17. The Seminary is open only to the most advanced students.

Methods of Teaching in Elementary and Secondary Schools (Philosophy 19). Asst. Professor HANUS and others.

About ten exercises for each of the following subjects: Physics, Chemistry, Physical Geography, Botany, Zoölogy, Physiology, Mathematics.

Omitted in 1896-97.

Elementary Physiology and Hygiene (Hygiene 1). Asst. Professor FITZ and Dr. BUNKER.

Tu., Th., Sat., at 10; laboratory work in sections. I, Tu., 9-10, and 11-1; II, Th., 9-10 and 11-1; III, Sat., 9-10 and 11-1; IV, Wed., 1.30-4.30; V, Fri., 9-12; VI, Fri., 1.30-4.30. Second half-year. (VIII)

And three courses chosen from the following and from the electives of the Third-Year, which were not taken in that year.

Experimental Psychology (Philosophy 2). Professor DELABARRE (of Brown University), Dr. DEARBORN, and Mr. LOUGH.

Mon., Fri., at 12, and four laboratory hours. First half-year. (IV)

Physiology and Histology of Plants (second course) (Botany 3). Mr. JONES.

Tu., Th., at 2.30, and Sat., at 10; laboratory work, six hours a week. (VIII and XI)

Comparative Anatomy of Vertebrates (Zoölogy 3). Dr. G. H. PARKER and Mr. HATHAWAY.

Tu., Th., Sat., at 9; laboratory work, nine hours a week. (VII)

Physiography — advanced course (Geology 20). Professor DAVIS.

Th., at 9, and a second hour at the pleasure of the instructor. (VII)

Advanced Geological field-work (Geology 22a). Mr. JAGGAR, in coöperation with Professors SHALER, DAVIS, and WOLFF, Asst. Professor SMYTH and Mr. J. B. WOODWORTH.

Tu., at 4.30.

Differential and Integral Calculus (Mathematics 5). Professor BYERLY.

Mon., Wed., Fri., at 11. (III)

Plane and Solid Analytic Geometry (Mathematics C) (extended course). Mr. HUNTINGTON.

Mon., Wed., Fri., at 2.30. (V)

ANATOMY, PHYSIOLOGY, AND PHYSICAL TRAINING.

The aims of this course are as follows:—

1. To afford a suitable general training for young men who may desire afterwards to pursue the study of Medicine.
2. To educate youths who may need to take particular care of their bodily health, and therefore should have a knowledge of the subjects taught in the course as well as a systematic training in the use of their bodies.
3. To prepare persons who, with or without a subsequent training in Medicine, may intend to seek employment as directors of gymnasiums or instructors in physical training.

Students who intend to enter the Medical School may take the prescribed First-Year's work of that school in satisfaction of the requirements of the Medical School year laid down in this schedule; they will thus be enabled to enter the Second-Year class at the Medical School and graduate from there in three years.

Students who complete this course of study and pass the required examinations will receive the degree of Bachelor of Science in Anatomy, Physiology, and Physical Training.

FIRST YEAR.

***Experimental Physics (Physics B).** Professor HALL and Mr. COLLINS.
Wed., at 12; laboratory work, two hours a week. (IV)

Elementary Zoölogy (Zoölogy 1). Dr. DAVENPORT and Mr. LINVILLE.
Tu., Th., and (at the pleasure of the instructor) Sat., at 10; laboratory work, three hours a week, in five sections: I, Tu., 9-10 and 11-1; II, Tu., 1.30-4.30; III, Th., 9-10 and 11-1; IV, Th., 1.30-4.30; V, Sat., 9-10 and 11-1. First half-year. (VIII)

Morphology of Animals (Zoölogy 2). Dr. G. H. PARKER and Mr. HAMAKER.
Mon., Wed., Fri., at 2.30; laboratory work, six hours a week. Second half-year. (V)

Morphology of Plants (Botany 2). Asst. Professor THAXTER.
Mon., Wed., Fri., at 2.30; laboratory work, six hours a week. First half-year. (V)

Elementary Physiology and Hygiene (Hygiene 1). Asst. Professor FITZ and Dr. BUNKER.
Tu., Th., Sat., at 10; laboratory work in sections: I, Tu., 9-10 and 11-1; II, Th., 9-10 and 11-1; III, Sat., 9-10 and 11-1; IV, Wed., 1.30-4.30; V, Fri., 9-12; VI, Fri., 1.30-4.30. Second half-year. (VIII)

General Descriptive Chemistry (Chemistry 1). Professor JACKSON, and MESSRS. FULLER, BOOS, GALLIVAN, GAZZALO, HOLLISTER, and MERIGOLD.
Mon., Fri., at 12; laboratory work, Tu., Th., 1.30-3.30, or Wed., Fri., 2.30-4.30. (IV)

Rhetoric and English Composition (English A). Professors A. S. HILL and BRIGGS, and MESSRS. HURLBUT, COPELAND, F. N. ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.
Divided into sections. I, *Mon., Wed., Fri., at 10*; II, *Mon., Wed., Fri., at 11*; III, *Mon., Wed., Fri., at 12*; IV, *Tu., Th., Sat., at 10*; V, *Tu., Th., Sat., at 11*; VI, *Tu., Th., Sat., at 12.* (X)

* Physics B may be omitted by those students who have passed in Experimental Physics for admission.

Elementary German (German A). MR. NICHOLS, DR. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer German for admission.

Or Elementary French (French A). Messrs. WRIGHT and LA MESLEÉ.

Mon., Wed., Fri., at 9. (XII)

Required of students who did not offer French for admission.

Gymnastics and Athletics. DR. SARGENT and MR. LATHROP.

SECOND YEAR.

Comparative Anatomy of Vertebrates (Zoölogy 3). DR. G. H. PARKER and MR. HATHAWAY.

Tu., Th., Sat., at 9; laboratory work, six hours a week. (VII)

Elementary Geology (Geology 4). Professor SHALEH and Messrs. J. B. WOODWORTH and WOODMAN.

Wed., Fri., and (occasionally) Mon., at 12. (IV)

Physiography (Geography 2). Professor DAVIS.

Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu. between 9 and 12, and additional laboratory and field hours. First half-year. (II)

Meteorology (Meteorology 1). MR. WARD.

Mon., Wed., Fri., at 10, a laboratory conference of one hour on Tu. between 9 and 12, and additional laboratory hours. Second half-year. (II)

Experimental Physics (Physics C). Asst. Professor SABINE and MR. HILL.

Fri., at 1.30; laboratory work, one afternoon each week from 2 to 6. Sections for laboratory work will be arranged for Mon., Tu., Wed., and Th., afternoons. (XIII)

Or General Descriptive Physics (Physics 1). Professor HALL and MR. McELFRESH.

Tu., Sat., at 10; laboratory work, two hours a week. (VIII)

Qualitative Analysis (Chemistry 3). Professor H. B. HILL, and Messrs. SYLVESTER, SOCH, HOLMES, and DOW.

Mon., Wed., Fri., at 11; laboratory work, nine hours a week. (III)

English Composition (English BC). Messrs. HURLBUT, HALL, and HAPGOOD.

Wed., at 1.30. (XIII)

Gymnastics and Athletics. DR. SARGENT and MR. LATHROP.

***THIRD YEAR.**

(AT THE MEDICAL SCHOOL).

Anatomy and Dissection. Professor DWIGHT, Drs. DEXTER, CONANT, and MUNRO.**Physiology.** Professors BOWDITCH and W. T. PORTER.**Histology.** Professor C. S. MINOT and Dr. QUINCY.**Hygiene.** Drs. HARRINGTON and DURGIN.**Foods and Cooking.** Boston Cooking School.**Medical Chemistry.** Professor HILLS, and Drs. WORCESTER and WENTWORTH.**Auscultation and Percussion.** Drs. GARLAND, GANNETT, and WITHINGTON.**Gymnastics and Athletics.** Dr. SARGENT and Mr. LATHROP.**†FOURTH YEAR.****Experimental Psychology (Philosophy 2).** Professor DELABARRE (of Brown University), Dr. DEARBORN, and Mr. LOUGH.*Mon., Fri., at 12, and four laboratory hours. First half-year. (IV)***Anthropometry (Hygiene 4).** Dr. SARGENT.*Three times a week. First half-year.***Applied Anatomy and Animal Mechanics (Hygiene 5).** Dr. SARGENT.*Three times a week. Second half-year.***Physiology of Exercise (Hygiene 3.).** Asst. Professor G. W. FITZ.**Remedial Exercises (Hygiene 6).** Dr. SARGENT and Asst. Professor G. W. FITZ.*Twice a week. Second half-year.***History of Physical Education (Hygiene 2).** Dr. SARGENT and Asst. Professor G. W. FITZ.*Mon., at 12. First half-year.*

(IV)

Forensics (English C). Asst. Professor BAKER, and Messrs. T. HALL, PRESCOTT, and R. M. ALDEN.*I, Tu., Th., at 10; II, Tu., Th., at 12; II, Tu., Th., at 1.30; IV, Tu., Th., at 3.30, and other hours to be appointed by the instructors.***Gymnastics and Athletics.** Dr. SARGENT and Mr. LATHROP.

* The work at the Medical School may be taken in the Fourth-Year by students intending to study medicine.

† The work of this year may be modified and taken in the Third-Year by students intending to study medicine.

DESCRIPTION OF COURSES.

The following brief description of the courses given in the various departments are added for the information of those who contemplate entering the School. Slight modifications may be made from time to time.

MATHEMATICS.

ENGINEERING 1a. — Engineering Mathematics. — Algebra. Messrs. LOVE and ASHTON.

This course is open to students who have passed satisfactorily the examination in Algebra required for admission to the Scientific School. The topics treated include the Progressions, Surds, and Imaginaries, Theory of Quadratic Equations, Binominal Theorem, Limiting Values, Undetermined Coefficients, Partial Fractions, Convergency of Series, Determinants, and Theory of Equations.

Text-book: Hall and Knight's *Higher Algebra*.

ENGINEERING 1b. — Engineering Mathematics. — Trigonometry. Messrs. LOVE and ASHTON.

This course is open to students having a working knowledge of the elementary Algebra and Plane Geometry required for admission to the Scientific School. The topics treated include Trigonometric Functions, Logarithms and Tables, Solutions of Triangles, Trigonometric Equations, Radian Measure of Angles, and applications of these subjects.

Text-books: Love's *Outlines of Plane Trigonometry*; Jones's *Logarithmic Tables*.

ENGINEERING 1d. — Engineering Mathematics. — Analytic Geometry. Messrs. LOVE and ASHTON.

This course is open to students who have passed satisfactorily in Courses 1a and 1b, or their equivalents.

The work in the course includes a study of the Geometry of the Straight Line, Circle, and other Conic Sections by the aid of the Cartesian and Polar Coördinates.

Text-book: Wentworth's *Coördinate Geometry*.

ENGINEERING 1c. — Engineering Mathematics. — Solid Analytic Geometry. — Differential and Integral Calculus. Mr. LOVE.

This course is open to students who have passed satisfactorily in Courses 1a, 1b, and 1d, or their equivalents, and have passed all the mathematical subjects required for admission.



In Solid Analytic Geometry, the work includes a simple treatment of Rectangular and Polar Coordinates in Space, the Point, the Plane and the Straight Line, Surfaces of Revolution, Ellipsoids, Paraboloids, Hyperboloids, etc.

In the Calculus are treated:—Differentiation; Maxima and Minima; Applications to Plane Curves; Developments in Series; Integration; Definite Integrals; Applications to Lengths, Areas, Surfaces, Volumes, Centers of Gravity, Motion, Moments of Inertia; Successive and Partial Differentiation; Indeterminate Forms; Contact and Curvature; Lengths of Space Curves; Successive Integration; Surfaces and Volumes of Solids of Revolution, etc.

Text-book: Lithographic reproductions of the Instructor's notes.

ENGINEERING 1f. — Engineering Mathematics. — Differential and Integral Calculus. (Second course.) Mr. LOVE.

This course is open to students who have passed satisfactorily in Course 1c, or its equivalent. It is intended as an optional course for Third-Year students of Engineering.

The work in this course consists of a fuller treatment of some of the topics introduced in Course 1c, such as Definite Integrals; Applications to Geometry, Physics, and Mechanics; Multiple Integrals; and Differential Equations.

Text-book: Byerly's *Integral Calculus*.

MATHEMATICS C. — Plane and Solid Analytic Geometry (extended course). Mr. HUNTINGTON.

Course C requires a preliminary knowledge of Plane Trigonometry.

It is intended to give the student a thorough working knowledge of the elements of Plane Analytic Geometry, and a less complete but valuable acquaintance with Analytic Geometry of Three Dimensions.

MATHEMATICS 2. — Differential and Integral Calculus (first course). Asst. Professor OSGOOD.

Course 2 is open to those only who have taken Course B, Course C, or Course F, or have otherwise satisfied the instructor of their knowledge of Trigonometry and Analytic Geometry. It will include:—

Differentiation and Integration of Functions of a Single Variable; Tangents and Normals to Plane Curves; Maxima and Minima; the Law of the Mean; Limiting Values; the Integral as the Limit of a Sum; Problems in Fluid Pressure, Centre of Gravity, Moment of Inertia,

Attraction, etc.; Curvature; Evolutes; Problems in Mechanics, Rectilinear and Constrained Motion of a Particle; Infinite Series, regarded primarily as a Means of Computation; Taylor's Theorem; Use of Infinitesimals in Geometrical and Mechanical Problems; Differentials of Different Orders; Differentiation of a Function of Several Independent Variables; Maxima and Minima of such a Function; Tangent and Normal Problems in Three Dimensions; Singularities of Curves.

Byerly's *Differential Calculus* and Byerly's *Problems in Differential Calculus* (Ginn & Co.) and *A Short Table of Integrals* (same publishers) will be used. A great deal of stress will be laid on the solving of problems.

MATHEMATICS 5. — Differential and Integral Calculus (second course). Professor BYERLY.

A student who takes this course must have a thorough acquaintance with the first principles of the Differential and Integral Calculus.

The subject will be continued from the point reached in Course 2. It will embrace: the elements of the theory of Functions of Imaginary Variables; the various methods of Integration, systematically treated; the elements of the theory of the Elliptic Functions; the geometrical and mechanical applications of the Calculus, treated with greater fullness than in Course 2; and some of the more important cases of Differential Equations.

The student should have Byerly's *Differential Calculus* (Ginn & Co.) and Byerly's *Integral Calculus* (2d ed., same publishers).

MATHEMATICS 10.—Trigonometric Series. — Introduction to Spherical Harmonics. — Potential Function. Professors BYERLY and B. O. PEIRCE.

The first part of this course is an introduction to the treatment of some of the important Linear Partial Differential Equations which lie at the foundation of modern theories in Physics, and deals mainly with the methods of building up solutions of a differential equation from easily obtained particular solutions, in such a manner as to satisfy given initial conditions. Fourier's Theorem and its application to the solution of problems in the Conduction of Heat and in Acoustics will be taken up, and the course will include a treatment of the theory of Spherical Harmonics and Bessel's Function.

The second part is devoted to the properties and uses of Force Functions in general, and of the Newtonian Potential Function in particular, and to the application of the last-named function to the solution of problems in Electrostatics, Electrokinematics, Magnetism, and Electromagnetism.

ENGINEERING.

ENGINEERING 2a. — Descriptive Astronomy. Dr. WILLSON.

In this course, the most important principles of Astronomy are treated, following closely the arrangement of Young's *Elements of Astronomy* and Young's *General Astronomy*, either of which may be used as a text-book and as a basis for examination at the end of the course.

ENGINEERING 2b. — Practical Astronomy. Use of instruments and applications to Navigation and Surveying. Dr. WILLSON.

This course is intended primarily for students of Civil Engineering. It requires a working knowledge of Trigonometry and of Solid Geometry.

The instruction given embraces the use of the sextant in determining latitude, longitude, and time, and of the surveyor's transit in laying out a true meridian line. It is designed to give facility in these fundamental problems rather than to cover a larger field less thoroughly.

Text-books: Greene's *Introduction to Spherical and Practical Astronomy*.

ENGINEERING 2c. — Practical Astronomy. — Determination of time, latitude, and longitude. — Use of the sextant and astronomical transit. — Lectures, instrumental work, and computation. Dr. WILLSON.

This course requires a working knowledge of Trigonometry and of the elements of Solid Geometry. It may be taken as a whole course instead of Courses 2a and 2b.

It is intended as an extension of Course 2b for those who wish to devote a longer time to the theory of the fundamental astronomical instruments and methods.

Text- and Reference-books: Greene's *Introduction to Spherical and Practical Astronomy*; Chauvenet's *Spherical and Practical Astronomy*.

ENGINEERING 3a. — Mechanical Drawing. — Descriptive Geometry. — Tinting, Isometric Drawing, Shades and Shadows, Perspective. Messrs. MOSES and TILDEN.

This course is given during the first year for all engineering students. It is largely of an elementary character, intended to prepare students for the work of the following years. It includes the use of draughting instruments; the stretching of paper, freehand and instrumental lettering and

problems in geometrical drawing; problems in the projection of points, lines, planes and curved surfaces with regard to tangencies, intersections and developments; shades and shadows; perspective; isometric and oblique projection; India ink tinting; tracing and blue printing; practice in freehand projection drawing continuing through the year and designed to give the student practice in the rapid measurement and delineation of parts of machines and of other engineering constructions.

Text-book: Church's *Descriptive Geometry*.

ENGINEERING 3c.—Structural and Machine Drawing.—Applications of Descriptive Geometry to engineering constructions and machinery. Mr. MOSES.

This course includes Stereotomy for students of Civil Engineering. It is open to students who have passed satisfactorily in Course 3a. It may be counted towards the degree of A.B. with the consent of the Chairman of the Department.

This course is intended for all Engineering students and is a continuation of the first year's work in drawing, and is designed to give a general knowledge of the process of making working drawings for different kinds of structures. Special attention is given to the making of freehand sketches from existing machines with all dimensions necessary to enable them to be used by the student in the preparation of complete working drawings. Sketches are also made to scale for direct use in the shop.

Reference-books: MacCord's *Machine Drawing*; Thorne's *Senior Course in Mechanical Drawing*; Warren's *Stereotomy*.

ENGINEERING 3d.—Mechanism.—Study of gearing and mechanical movements. Mr. MOSES.

This course is open to students who have passed satisfactorily in Course 3c. It may be counted towards the degree of A.B. with the consent of the Chairman of the Department.

In this course the transmission and change of motion by means of toothed wheels, link work, belts, and special devices are taken up in both their theoretical and practical aspects. Problems comprising these different modes of transmission are worked out in the draughting-room, particular attention being paid to the construction of teeth of wheels by exact and approximate methods. Analyses of simple machinery and calculations for trains of wheel work, belting, etc., are made in order to give the student thorough grounding in the principles of pure mechanism.

Text-book: Stahl and Wood's *Elementary Mechanism*.

ENGINEERING 4a. — Surveying, Plotting, and Topographical Drawing. — Levelling. — Field practice. Messrs. TURNER and HOPKINS.

This course is open to students who have a working knowledge of Plane Trigonometry, or who take at the same time Course 1b. It extends five weeks into the summer, for practice in the field. The summer practice begins as soon as possible after the final examinations. Without the summer work, this course may count as a half-course towards the degree of A.B., except for Seniors.

The work of the course extending through the first half-year includes the study of the theory and adjustments of the several surveying instruments, together with their practical use in the field in working out numerous problems. Instruction is also given in map lettering and topography. In the second half-year the work consists of a study of the methods of making land, topographical, city and hydrographic surveys, and of measuring volumes in earthwork. In the study of topographic methods, the student is taught how such surveys are conducted by the U. S. Geological and Coast and Geodetic Surveys, and also those methods used in general engineering practice. Practice is also given in city survey work. The five weeks during the summer are devoted to making a topographical survey with transit and stadia and with the plane table, and also to hydrographic work.

Text-book : Johnson's *Theory and Practice of Surveying*.

Reference-books : Baker's *Engineering Instruments*; Gannett's *Topographic Methods*; U. S. *Coast and Geodetic Survey Reports*; Association of Eng. Soc's. *Reports*.

ENGINEERING 4c. — Geodetic, Mining, and Hydrographic Surveying. — Field practice. Messrs. TURNER and HOPKINS.

This course is open to students who have passed satisfactorily in Courses 1b, 3a, and 4a. Courses 4c and 4d extend five weeks into the summer, for practice in the field. The summer practice begins as soon as possible after the final examinations. Without the summer work, Courses 4c and 4d together may count as a half-course towards the degree of A.B. With the summer work, each of them may count as a half-course towards the degree of A.B. with the consent of the Chairman of the Department.

The course includes the methods of measuring base lines with special reference to the use of the steel tape, observing angles, adjusting angle observations, adjusting triangulations, trigonometrical levelling, precise spirit levelling, and projecting maps. In mining surveying is treated the methods of laying out mining claims and making underground surveys. The work in hydrographic surveying consists of making the map from the

notes of the survey made during the previous summer. The work during the summer consists of the measurement of a base line and angles necessary for the computation and adjustment of a small triangulation, the filling in of the topography of the same being done by the students in Course 4a.

Text-book: Johnson's *Theory and Practice of Surveying*.

Reference-books: U. S. Coast and Geodetic Survey Reports.

ENGINEERING 4d. — Railroad Engineering. — Survey, location, and construction of railroads. — Field practice. Mr. TURNER.

This course is open to students who have passed satisfactorily in Course 4a.

See note under Course 4c.

The course includes a study of the principles necessary to enable the engineer to select a route for a railroad, to determine the necessary grades and curves, to solve the problems incident to the location of the line upon the ground, to compute the quantities in excavation and embankment, and finally to lay the track in place. During the summer the students survey a line three or four miles long, take topography, make a map location, and adjust the location to the ground, computing the cost of construction.

Text-book: Searles's *Field Engineering*.

Reference-books: *Railroad Engineering Field Book* by Godwin; Searles's *Spiral*; Wellington's *Economic Theory of the Location of Railways*.

ENGINEERING 4e. — Construction and Maintenance of Common Roads. Mr. McCLINTOCK.

This course cannot be counted towards the degree of A.B.

The course is intended to furnish a training in the construction and maintenance of ordinary highways. The location and survey of roads are treated in reference to the conditions governing such work. Foundations and selections of materials, the treatment of the road materials in construction, and the surface finish for various classes of traffic, receive careful attention. The various kinds of city pavements for heavy traffic are also considered. Students will be provided with opportunities for practical experience in the details of road building. The region in the vicinity of the School affords excellent examples of the various methods practised in constructing streets and other highways.

Text-book: Byrne's *Treatise on Highway Construction*.

ENGINEERING 5a. — Analytic and Applied Mechanics. — Problems in Statics and Kinetics. Professor HOLLIS and Asst. Professor JOHNSON.

This course is open to students who have passed satisfactorily in the Mathematics and Physics prescribed for the first and second years of the Engineering course, or their equivalents.

The course in Mechanics is given during the third year. It includes the treatment of Statics and Kinetics from the standpoint of the engineer, dealing mainly, however, with the fundamental principles of Mechanics and leaving for subsequent courses fuller and more detailed applications required in various branches of engineering practice. The elementary principles of Resistance of Materials are also considered. Special stress is laid upon the solution of problems by the students.

This course is also given in a modified form for students of Architecture. A large part of their time is devoted to Graphical Statics and to elementary problems in structural work.

Reference-books: Rankine's *Applied Mechanics*; Weisbach's *Mechanics of Engineering*.

ENGINEERING 5c. — Resistance of Materials. — Testing materials used for structural purposes. Professor HOLLIS.

This course is open to students who have passed satisfactorily in Course 5a, or Mathematics 4.

The course in Resistance of Materials is designed to give the student a comprehensive knowledge of the nature of all materials used in engineering construction, including the laws of their behavior under stress, both above and below the elastic limit. The application of theoretical formulas to structures is illustrated by numerous tests of iron and steel, cement, stone, etc., in the testing-machines of the department, and the characteristics of materials are thus shown in a practical manner. The commercial tests and requirements are given from the standpoint of the practising engineer.

Text-book: Merriman's *Mechanics of Materials*.

Reference-book: Burr's *Elasticity and Resistance of Materials of Engineering*.

ENGINEERING 6a. — Hydraulics and Hydraulic Motors. — Flow of water in pipes. — Water wheels, turbines, and pressure engines. Messrs. TURNER and HOPKINS.

This course is open to students who take or have passed satisfactorily Course 5a, or Mathematics 4.

The first part of the course is devoted to the study of the general theory of Hydraulics, which is more or less applicable to all branches of Hydraulic Engineering, including, among other things, the discussion of the laws governing the flow of water through orifices, over weirs, through tubes, and through pipes. The second part of the course is a study in the theory and practice of hydraulic motors. Visits are made to the Lowell and Holyoke water powers. Some time is given to the study of windmills.

Text-book: Merriman's *Hydraulics*.

Reference-books: Hamilton Smith's *Hydraulics*; Francis' *Lowell Hydraulic Experiments*; Bodmer's *Hydraulic Motors*; Bovey's *Hydraulics*.

ENGINEERING 6c. — Water Supply and Sanitary Engineering. Mr. RICE.

This course is open to students who have passed satisfactorily in Course 6a. It cannot be counted towards the degree of A.B.

This course is given in the second term of the Fourth-Year. The considerations necessary for the complete design of water-supply systems by gravitation, pumping, and ground storage, from the survey of the watershed to the delivery into the house, are taken up in detail and in accordance with the latest practice.

The effects of soil on water, and the importance of the geological character of the water-shed, as well as the conditions effecting the plan of storage and determining the supply, are all carefully considered.

The pollution and filtration of potable waters, as well as the whole subject of sanitary engineering, including the best methods of utilization and disposal of sewage, are treated in the light of the latest experience.

Text-book: Fanning's *Practical Treatise on Water-Supply and Sanitary Engineering*.

ENGINEERING 6d. — Canals, Rivers, and Irrigation. — Measurements of the flow of water. — Construction of irrigation works. Mr. TURNER.

This course is open to students who have passed satisfactorily in Courses 6a and 8a. It may be counted towards the degree of A.B. with the consent of the Chairman of the Department.

The course includes: the study of rain-fall, evaporation, flow-off from the catchment area, models of measuring river discharges, the laws governing the flow in rivers, and methods of river improvement; the discussion of the theory of the flow in canals, and methods of constructing canals; the solution of the problems pertaining to irrigation engineering, such as the location and construction of canal head and

regulating works, control and drainage works, and laterals and distributaries.

Reference-books : Fanning's *Water-Supply and Hydraulic Engineering*; F. H. Newell, in *U. S. Geological Survey Reports* and *Eleventh Census*; Humphrey and Abbott's *Mississippi River Experiments*; Wilson's *Irrigation Engineering*.

ENGINEERING 7a. — Bridges and Buildings. — Graphical Statics. — Details of iron and steel construction. Lectures and draughting. Asst. Professor JOHNSON.

This course is open to students who take or have passed satisfactorily Course 5c. It cannot be counted towards the degree of A.B.

The course is intended to give systematic training in the principles and methods involved in the economical design of iron and steel structures, such as bridges, roofs, and buildings.

The first few weeks of the year are devoted to giving the students a working knowledge of Graphical Statics and the rest of the year to structural design proper. In this latter portion of the course, each student works out complete designs of typical structures of moderate size. Special attention is given to inculcating business-like methods of making and recording computations. Students make working drawings of their projects, taking, however, no more time for such work than is necessary for making suitable presentation of their designs, and for obtaining some practice in expressing their own ideas clearly and in detail by drawing.

Special problems which arise in connection with structures other than those designed in detail by the student are taken up in lectures and exercises. In this work, a prominent purpose is to train the student in making prompt and correct application of general principles already familiar to him.

Such knowledge of rolling-mill, shop and erection practice as is needed for a clear understanding of the requirements of good design is obtained from manufacturers' hand-books, from visits to neighboring bridge works, and to bridges and buildings in course of construction, and from lectures.

Text-book : Johnson, Bryan & Turneaure's *Theory and Practice of Modern Framed Structures* (latest edition).

Reference-books : Merriman & Jacoby's *Roofs and Bridges*; Müller-Breslau's *Graphische Statik der Baukonstruktionen*, and others.

ENGINEERING 8a. — Masonry and Foundations. Asst. Professor JOHNSON.

This course cannot be counted towards the degree of A.B.

Under the head of Masonry a study is made of the materials used in masonry construction, with reference to their physical properties, methods

of preparation, cost, and their proper application to structures. Special attention is given to the conditions of stability of bridge piers, high masonry dams and arches.

The different systems of foundation are described and discussed with reference to their comparative merits and proper fields of application. Some leading topics in this part of the course are piles and pile-driving, cofferdams, open caissons, pneumatic and open crib work, etc. The instruction in tunnels will consist of descriptions of the principal systems of excavation and timbering, of drilling machinery and explosives.

Reference-books : Baker's *Masonry Construction* ; Patton's *Foundations* ; Drinker's *Tunneling* ; Degrand et Résal, *Ponts en Maçonnerie*.

ENGINEERING 10a.* — Shop work in Metals. — Use of tools.—Fitting by hand. — Study of the metals in practical working. — Lectures and laboratory work. **Mr. BURKE.**

The workshop courses may be taken on any two afternoons in the week, the days to be arranged at the beginning of the term to avoid interference. Volunteer classes will be made up immediately after the final examinations for five weeks work in the summer, provided a sufficient number of students apply. Any two of the workshop courses may be taken during this period.

Students of Mechanical and Electrical Engineering are required, during the first two years, to spend about six hours a week in the blacksmith shop, pattern shop, foundry and machine shop. The shop work is supplemented by lectures on workshop practice and visits to the workshops within reach of Cambridge, as the aim of the courses is to give men a good practical knowledge of materials and the methods of manufacture adapted to the different engineering requirements. It is not manual craft that is considered desirable, but knowledge which will enable men to make economical and practical designs of machinery.

Courses 10a and 10b are given during the First-Year and the other courses during the Second-Year. Each class is divided into sections for the purpose of reducing the number of students under instruction at one time and to avoid conflicts with other studies. It is considered desirable to take this work during the early part of the summer, when students can devote their entire time to it, and any workshop course may be omitted during the year if so taken during the summer.

The Rindge Manual Training School, situated near the University, is at present used for the above mentioned instruction. It has complete equipment for about one hundred and fifty students, with all facilities for practical instruction in blacksmithing, fitting, finishing, and pattern making.

* Courses 10a, 10b, 10c, 10d, and 10e cannot be counted towards the degree of A.B.

ENGINEERING 10b. — Blacksmithing. — Use of tools. — Forging, welding, tool-dressing and tempering. — Lectures and laboratory work. **MR. BURKE.**

See starred note under Course 10a.

ENGINEERING 10c. — Shop work in Wood. — Use of tools. — Pattern-making and turning. — Lectures and laboratory work. **MR. BURKE.**

See starred note under Course 10a.

ENGINEERING 10d. — Foundry Practice. — Moulding. — Casting in iron and alloys. Mixing Metals. — Lectures and laboratory work. **MR. BURKE.**

See starred note under Course 10a.

ENGINEERING 10e. — Machine Shop Practice. — Use of machine tools. — Construction of parts of machinery; finishing and assembling parts. — Lectures and laboratory work. **MR. BURKE.**

This course is open to students who have taken Courses 10a and 10b.
See starred note under Course 10a.

ENGINEERING 11a. — Machinery and Boilers. — Description of the different types of engines and boilers. **MESSRS. L. S. MARKS and BURKE.**

This course is open to students who have passed satisfactorily in Course 3a. Wednesday afternoons must be kept free for visits of inspection.

The course consists mainly of description of the construction and operation of the more common forms of steam machinery.

In the first half-year, the different types of steam boilers, their attachments and settings, operation and maintenance, are described and discussed. The subject of fuels, solid, liquid, and gaseous, including the devices in use for their economical combustion, receives attention. This is followed by a study of the construction and operation of the various forms of stationary engines. Compounding, governing, counterbalancing, the action of the fly-wheel, and the effects of the inertia of the reciprocating parts are treated in an elementary manner. The methods of action of the common forms of valves and valve gears are explained. The erection and general maintenance of engines are dealt with.

The second half-year is devoted to the discussion of special types of steam machinery. These include pumps, for both water supply and power purposes, marine and locomotive engines, hoisting and air-compressing machinery.

A series of visits of inspection to various machinery plants, in the neighborhood, are arranged in order to make the students familiar with the machines described. The resources of the laboratory are also fully utilized for the same purpose.

ENGINEERING 11b. — Steam-Engine and Boilers. — General theory and design. — Valve gears and governors. Mr. L. S. MARKS.

This course is intended primarily for students of Mechanical Engineering, but it is open to all students who have passed satisfactorily in the first half of Course 11a. It cannot be counted towards the degree of A.B.

The course presupposes knowledge equivalent to that acquired in Course 11a. It takes up the general design of steam boilers and engines, leaving, however, the design of such parts as are proportioned specially for strength to be treated in Course 14a.

The subjects considered in this course include the determination of the necessary heating surface and grate area in boilers, the design of chimneys, the calculation of power developed in steam engine cylinders, the proportioning of multi-cylinder engines, analysis of the action of the common valve gears, the methods of regulating the speed of an engine and of reducing the variations in rotative effort. These subjects are treated with sufficient completeness to enable the student to make intelligent design of the members concerned. Numerous problems in design are worked out by the students.

ENGINEERING 12a. — Efficiency and Economics of Engines and Boilers. Mr. L. S. MARKS.

This course is open to students who have passed satisfactorily in Course 1c, 11a and Physics 6¹.

In this course the steam engine is considered from the thermo-dynamic and financial standpoints. The sources of loss of efficiency are individually analyzed and the methods of reducing the losses, by compounding, jacketing, superheating, and by other means, are discussed. The effects of these losses on the cost of steam power and the considerations determining the choice of the type of steam engine to be used under any given conditions are dealt with. Gas and oil engines are similarly studied, and are compared with the steam engine.

Other topics which are taken up include the theory and efficiency of injectors, the flow of steam in pipes and through orifices, the design of safety valves, the condensation of steam in surface and jet condensers, the thermo-dynamics of air-compressing and refrigerating machinery, and the theory of steam turbines.

ENGINEERING 12c.—Heating and Ventilation of Buildings. Mr. BURKE.

This course cannot be counted towards the degree of A.B.

The heating and ventilation of buildings receives the treatment necessary to supplement instruction bearing on this topic given in other courses. Instruction in this course includes the consideration of forms of boilers for heating, with their settings, the sizes and leads of pipes for the distribution of steam, hot water, and hot air; the positions and proportions of radiators, and, in general, the practical details of installing heating plants. The use of exhaust team, and the hot blast system, in connection with the heating and ventilation of mills, factories and other large buildings, receives attention. Students are required to design heating and ventilation plants suitable for public buildings.

ENGINEERING 13a.* — Engineering Laboratory. — General course in experimental methods. Mr. L. S. MARKS.

Course 13a may be counted towards the degree of A.B. with the consent of the Chairman of the Department.

The prime object of this course is to give instruction in the methods of carrying out investigations in engineering subjects and to make the student practically acquainted with the instruments used for that purpose.

The investigations which are carried out include the calibration of the various instruments, such as steam engine indicators, transmission and absorption dynamometers, thermometers and pressure gauges; the determination of the efficiencies of hoisting gears, steam boilers, steam engines, pumps, gas engines, blowers, water wheels; the investigation of the efficiency of the transmission of power by ropes and belts; the measurement of the friction of journals; and of the flow of water through orifices and over weirs; the testing of the strength of wrought iron, steel, cast iron, wood, stones, bricks and cements under tension, compression, bending, impact and torsion. Practice is also given in gas analysis, in the use of steam calorimeters and in valve setting.

* Courses 13a, 13b, and 13d are intended primarily for students of Engineering, but they may be taken by others after consultation with the instructor. Courses 13b and 13d cannot be counted towards the degree of A.B.

ENGINEERING 13b. — Engineering Laboratory. — Advanced course in Experimental Engineering. Mr. L. S. MARKS.

See starred note under Course 13a.

In this course accurate tests are made of a steam boiler under both natural and forced draught, and both with and without a feed water heater. Tests are also made of steam engines, with and without condensing, of injectors, and gas and oil engines. Investigations are made on steam calorimeters, on the transmission of heat through iron plates, on the radiation of heat from iron and from surfaces covered with non-conducting materials. Tests of power plants are made whenever opportunity offers. The latter end of the course is devoted to research work on some special subject.

ENGINEERING 13d. — Engineering Laboratory. — Measurement of the flow of water, and testing hydraulic machinery. Mr. TURNER.

See starred note under Course 13a.

This course is intended mainly for students in Civil Engineering, and is open only to those who have obtained some practice in the use of instruments in Course 13a. It deals mainly with the flow of water through orifices and over weirs. The efficiency of turbines is investigated practically. Students are allowed access to the apparatus at other hours than those given above if they wish to pursue any special line of investigation.

ENGINEERING 14a. — Machine Design. — Designing the parts of machinery. — Methods for proportioning the parts for strength and effect. Mr. MOSES.

This course is open to students who have passed satisfactorily in Course 8d and who take or have taken Courses 5a and 11a. It may be counted towards the degree of A.B. with the consent of the Chairman of the Department.

Text-book: Low & Bevis' *Machine Design*.

ENGINEERING 14b. — Machine Design. — Completed designs of machinery with estimates and specifications for contractors. Professor HOLLIS.

This course is open to students who have passed satisfactorily in Course 14a. It cannot be counted towards the degree of A.B.

The designing of machinery continues through the last two years, the instruction being carried on in connection with the study of the steam

engine, pumps, and hydraulic motors. Completed designs of the whole and parts of given machines are made as the students acquire the proper knowledge of the subjects. Designs for installing workshop and mill machinery form a feature of the course.

The two courses in design are given mainly by lectures and work in the draughting-room.

ENGINEERING 16a. — Industrial Applications of Electricity. Asst. Professor ADAMS.

This course is intended primarily for students of Civil and Mechanical Engineering. It cannot be counted towards the degree of A.B.

The use of electricity for the transmission of power, for operating cranes, mining machinery, street railways, and for the prosecution of other engineering work, renders a general knowledge of the subject necessary to the civil, mechanical, and mining engineer. This course is intended to supply this want. It begins with a brief review of the fundamental principles of Electricity and Magnetism, and later takes up the applications of these principles in the various kinds of electrical machinery.

Visits are made to electric light and power plants and to manufactories of electrical machinery.

Text- and Reference-books: S. P. Thompson's *Elementary Lessons in Electricity and Magnetism*, and S. P. Thompson's *Dynamo Electric Machinery*.

ENGINEERING 16c. — Direct Current Dynamo-Electric Machinery. — Theory, testing and practice in management. Asst. Professor ADAMS and Mr. SHAW.

This course is open to students who have passed satisfactorily in the Mathematics and Physics prescribed for the first and second years of the course in Electric Engineering, and who take or have taken Physics 8.

The lectures begin with a brief review of the laws governing the flow of steady currents and the laws of electromagnetic induction. These laws are then applied in the study of the theory of direct current measuring instruments, electrical machinery and apparatus of various kinds.

The design of the above mentioned apparatus is also carefully studied, and in this study, commercial and economic, as well as theoretical questions, are considered.

The work in the laboratory follows the same general outline as that of the lectures. Beginning with the study and calibration of electrical measuring instruments, the student takes up a few experiments on the

magnetic properties of iron and steel, and then the experimental study of direct current electrical machinery.

The tests of generators include measurements of resistance of armatures, fields, and insulation; observations of heating and sparking; the taking of characteristic, saturation, potential and efficiency curves; measurements of magnetic leakage and a study of armature reaction.

Most of the above tests are common to both generators and motors, but in case of the latter, speed-characteristic and load curves are also taken.

* In many of these experiments the student predetermines the results as nearly as possible by theoretical calculation and compares them with the observed results, tracing out the causes of error.

* After each experiment the student is required to write a detailed report of his work, clearly explaining the phenomena observed and the causes of any peculiarities. Throughout the course great stress is laid upon this part of the work.

* Occasional visits are made to the electric light and power plants, and to the manufactories of electrical machinery, in Boston and its vicinity. During these visits the students are required to make a careful study of any novel points in the equipment, and afterwards to make a written report of the same.

Reference-books: S. P. Thompson's *Dynamo Electric Machinery*; Jackson's *Electro-Magnet and Dynamo Construction*; Ewing's *Magnetic Properties of Iron and other Metals*.

ENGINEERING 16d. — Direct Current Dynamo Electric Machinery.

— Continuation of Course 16c, with practice in design and construction. Asst. Professor ADAMS and Mr. SHAW.

This course is open to students who have passed satisfactorily in Course 16c. It cannot be counted towards the degree of A.B.

ENGINEERING 16e.* — Alternating Currents and Alternating Current Machinery. — Theory and testing. Asst. Professor ADAMS and Mr. SHAW.

This course is open to students who have passed satisfactorily in Course 16c.

The course follows Course 16c and takes up the study of alternating current apparatus in a manner similar to that in which Course 16c takes up the study of direct current apparatus.

* Starred paragraphs under Course 16c apply to Course 16e.

The lectures begin with a study of the flow of alternating currents and the effects of inductance, capacity and frequency, and then take up the generation, measurement, transformation, transmission, and utilization of such currents.

In the laboratory, the first series of experiments is designed to familiarize the student with the effects of inductance, and capacity in alternating current circuits, with the methods of measuring these quantities, and with the magnitudes of their practical units. Then follow experiments on alternators, transformers and alternating current motors, some of the more important of which are : —

The taking of characteristic, efficiency and saturation curves of alternators; measurements of armature inductance and armature reaction; observations of the operation of synchronous motors with curves showing limit of stability, and experiments showing the effect of armature resistance and inductance upon the same; the taking of speed characteristic, efficiency, power factor and other curves from induction motors; experiments showing the influence of armature resistance and inductance upon the speed characteristics and outputs of induction motors; regulation and efficiency of transformers with separation of losses; current and E.M.F. curves from transformers.

ENGINEERING 16f. — Alternators, Transformers, Alternating Current Motors and Allied Apparatus. — Continuation of Course 16e, with practice in design and construction. Asst. Professor ADAMS and Mr. SHAW.

This course is open to students who have passed satisfactorily in Course 16e. It cannot be counted towards the degree of A.B.

The two half courses (16d and 16f) are given as one full course in the Fourth-Year of the prescribed work in Electrical Engineering, and are intended primarily for students in Electrical Engineering.

The work of these courses is chiefly in the laboratory, supplemented by occasional lectures and conferences.

In this work the students are thrown as much as possible upon their own responsibility, and each one takes up some particular line of investigation, or the design of a piece of electrical machinery, or of an electrical plant. Occasionally two or three students take up together the study of some existing plant, making tests of the plant as a whole, or of particular parts which may be available for that purpose.

In every case a careful report is required.

At the conferences the students meet with the instructors, report the progress of their work and discuss any difficulties that may arise. In this way each student derives benefit from the work done by the others.

ENGINEERING 18a.—Metallurgy.—Manufacture of the metals used in engineering construction.—Lectures on the practical working of iron and steel. Mr. BURKE.

This course is intended primarily for students of Civil and Mechanical Engineering, but it may be taken by others. It cannot be counted towards the degree of A.B.

The instruction relating mainly to Iron and Steel, is intended to supply the student with a thorough knowledge of the metals he will have to use in his professional work. It precedes the instruction in the Resistance of Materials, and consists of a full course of lectures on the manufacture of iron and steel, together with their handling in the foundry, forge shops, and rolling mill. Numerous specimens, showing various stages of the processes treated, are used, and, whenever possible, visits are made to the workshops within reach of Cambridge.

ENGINEERING 21.—Engineering Conference on the general theory of Machinery and the commercial and economic questions involved in the selection of types of machinery for given localities and duties.—Comparison of different methods of transmitting power. Professor HOLLIS.

This course is intended primarily for Fourth-Year students in all branches of Engineering. It cannot be counted towards the degree of A.B.

The course is conducted mainly by the students, and deals with current problems in Engineering, referring freely to transactions of engineering societies and to the periodicals. See note under Thesis.

ENGINEERING 22.—Contracts and Specifications.—The principles of Common Law as applied to contracts.—Practice in drawing up specifications. Mr. ARCHER.

This course cannot be counted towards the degree of A.B.

It consists of about fifteen lectures on law, with practice in drawing up contracts and specifications for various projects.

Thesis.

The subject for a thesis must be selected by the student at the end of his Third-Year. It must involve considerations which will assist in his professional education. Sufficient time is given during the Fourth-Year for experimental investigation and visits to engineering establishments in connection with the thesis, a copy of which must be left with the Department for future reference. If the work done by the student in Course 21 is of high character it may satisfy the requirement of a thesis.

MINING AND METALLURGY.

MINING 1. — Prospecting and Exploring. Asst. Professor SMYTH.

This course deals with those practical methods of Field-geology which have for their object the discovery of mineral deposits, and the approximate determination of their extent and value. Especial attention is devoted to magnetic surveys with the dial-compass, dip-needle and magnetometer, and their application to certain fields in the Eastern States and the Lake Superior region. Other subjects treated are test-pitting, drilling, panning, sampling, and rough methods of field analysis.

The instruction is given by lectures, illustrated with maps, photographs, and specimens. During the term, an excursion will be made to localities in New England and New York, chiefly for the purpose of practice in the use of the magnetic instruments.

METALLURGY 2. — Metallurgy of iron and steel, copper and nickel.

Lectures, reading, and excursions. Mr. FORSYTHE.

Chemistry 1, or its equivalent, is required as a preparation for this course.

The first part of the course will be devoted to the study of iron and steel. Under the subject of iron will be considered the methods of making pig- and wrought-iron, including a description of plants, a discussion of materials used and products obtained, and the uses to which the products are adapted.

Under steel, the methods of making various grades of steel will be considered, and the chemical and physical differences of the products will be discussed.

Under copper will be included a description of plants, and a discussion of the mechanical and chemical problems involved in the treatment of ores, smelting, and the refining of products. The discussion of nickel will follow similar lines.

Opportunities to visit metallurgical plants will be given at intervals during the term, and the Christmas recess will be devoted to a more extended excursion.

METALLURGY 3. — Metallurgy of lead, zinc, gold, silver, and the minor metals. Lectures, reading, and excursions. Mr. FORSYTHE.

Chemistry 1, or its equivalent, is required as a preparation for this course.

Under lead will be included a discussion of the choice and preparation of materials, smelting by various methods, and the desilverization and refining of products.

Under gold and silver, the various details of amalgamation of free-milling and sulphide ores, and the successful leaching processes, will be considered.

The metallurgy of zinc will include a description of the methods of producing spelter and zinc-white, and a discussion of the phenomena accompanying the processes.

As much time as can be spared from the more important metals, will be devoted to the metallurgy of the minor metals.

An opportunity to visit metallurgical plants will be given during the April recess.

MINING 5.—Metal and Coal Mining. Excavation, development, underground and surface transportation, drainage, ventilation, etc. Lectures and reading. Asst. Professor SMYTH.

The first three years' work in the Four Years' Course in Mining and Metallurgy is required as a preparation for this course.

The instruction is designed to give a systematic account of the operations incident to the development and working of coal-seams, and ore-bodies of various forms, sizes, attitudes and physical characters, under different conditions. The subjects treated are surface-excavation, hydraulic and open-pit mining, tunnelling, shaft-sinking, hand- and power-drilling, explosives, systems of mining, tramming and underground-haulage, hoisting, surface-handling, drainage and ventilation.

The instruction is given by lectures supplemented by required reading in various text-books and in professional literature. The lectures are illustrated with maps and photographs. During the term short excursions will be made to mines in New England and the neighboring States.

METALLURGY 6.—Metallurgical Chemistry. — The analysis of ores, metals, slags, fuels, and refractory materials. Fire-assaying. Chiefly laboratory work. Mr. FORSYTHE.

Chemistry 4, or its equivalent, is required as a preparation for this course.

Text-books: Blair's *Chemical Analysis of Iron* and Furman's *Manual of Practical Assaying*.

This course will consist chiefly of laboratory work, with an occasional lecture at one of the hours named. About ten hours a week in the laboratory will be necessary, in the case of average students, to complete the assigned work.

The subjects for analysis will be ores of iron, copper, nickel, lead, zinc, etc.; metallic products, such as pig-iron, steel, mattes, spelter, etc.; slags resulting from the heat-processes; fuels and fluxes, and refractory materials.

The fire-assaying will be restricted to ores carrying the precious metals.

The object of the course is to teach the student to work rapidly by using the various quick methods in present use, and by conducting several determinations at the same time.

GEOLOGY.

GEOLOGY 4. — Elementary Geology. — Lectures, with collateral reading. Professor SHALER, Mr. J. B. WOODWORTH, and an assistant.

This course gives a general knowledge of Geology which may serve either as an outline of this branch of Natural History for those whose main line of study is in other directions, or as a basis for further geological work for those who intend to devote themselves to Geology. (See Geology 5, below.)

The lectures, as far as possible, will be illustrated by lantern slides.

Voluntary field excursions are offered in connection with this course in the autumn and spring.

GEOLOGY 5. — Elementary Field and Laboratory Geology. Mr. J. B. WOODWORTH and an assistant.

Course 5 may be taken only with or after Course 4. Courses 4 and 5, or their equivalents, are required for admission to the higher courses in Geology (8, 16, 27, 17, 14, 18, 10, 18). In previous years Course 4 included the work here described under Courses 4 and 5.

The laboratory exercises in this course are designed to illustrate by means of specimens, models, photographs, stereopticon views, maps, and sections, the principal original and secondary structures of rocks; the origin and mode of occurrence of rocks in the earth's crust, their cycles of alteration and change; their interpretation and representation in geological surveys. The following topics are especially considered: volcanoes, rivers, glaciers, marine erosion and deposition, organic agencies, geological evidences of the development and history of the earth.

The field excursions comprise a series of observations upon the weathering of rocks; sea-shore phenomena, including beaches, cliffs, marine marshes; glacial phenomena, including glacial erosion, moraines, drumlins, glacial sand-plains, eskers, kames; igneous rocks, including dikes, sills, ancient lava-flows, local or contact metamorphism and the genesis of new minerals; stratified rocks, including basal sections, arkose beds, simple and compound conglomerates, sandstones, slates; Cambrian and Carboniferous strata with characteristic fossils; faulted igneous and sedimentary rocks; folds; joints, cleavage, schistosity, etc.

Opportunity will be given for practice in constructing maps and sections, measuring the thickness of strata, and determining the relative age of geological structures. The exercises in the field and laboratory are intended as a basis for more extended observation and training in the advanced courses in the Department.

GEOLOGY 8. — General Critical Geology. — Lectures, field-work, reports, and reading. Mr. J. B. WOODWORTH and an assistant.

Course 8 is open to those students only who have attained satisfactory grades in Courses 4 and 5, or their equivalents (see Course S1, p. 114). Students taking this course must keep Thursday or Friday afternoon free for field-work.

The lectures treat of the principles of classification of geological phenomena, the geological processes, their products and criteria; the nature of the forces involved therein; volcanic phenomena; movements of solid masses; the action of water, ice, wind, and life; geological history, including the physical changes, rocks, life, and climate of the principal periods, with reference to evolutionary hypotheses, time ratios, continuity of geological processes, etc. Lantern slides are frequently used in illustration of the lectures.

The field-work consists of half-day excursions to localities in the neighborhood of Cambridge, illustrating problems in Structural and Physical Geology.

The class will be divided into sections for review and consultation. Geikie's *Text-book of Geology*, 3d ed., 1898, is required for collateral reading.

GEOLOGY 10. — Mining Geology. — Lectures, reading, and occasional field-work. Asst. Professor SMYTH.

Geology 4 and 5, and Mineralogy 2, or their equivalents, are required as a preparation for Course 10.

The lectures treat of the origin and geological relations of ore deposits, and of methods of mining. It is expected that during the term a few excursions will be made to the nearest mines.

The instructor will direct the field-work of students in this course in selected mining districts during the summer vacation.

GEOLOGY 14. — General Palaeontology. — Lectures and theses. Professor SHALER and Dr. JACKSON.

This course is open to those only who have passed in Geology 4 and 5, or who have an equivalent preparation. The ability to read scientific French and German is desirable.

The course is intended to give an acquaintance with the geological history of the various organic series, from the point of view of the student of organic life in general rather than in the way required by the practical geologist. Special attention is devoted to the theories concerning the origin and development of animals as far as these questions are brought into view in the palaeontological record. The course varies from year to year, but the following synopsis will indicate the subjects generally treated: Conditions of organic life; heat, moisture, etc.; laws of the distribution of life on land and sea; conditions of fossilization; metamorphism and the preservation of the geological record; climatical and other evidence afforded by fossils. General history of the great divisions of the animal kingdom; the development of the motor system in animals; development of the skeletal, nervous, visual, reproductive, and other systems of the divisions; theories concerning the appearance and disappearance of animals as shown by fossils; palaeontological history of man.

GEOLOGY 15. — Historical Geology. — Laboratory and field-work, with conferences and theses. Professor SHALER and Dr. JACKSON.

This course is open to those only who have some knowledge of Geology and Palaeontology. Geology 8, 82, and 13 or 14, and Zoölogy 2 afford a suitable preparation.

The course is designed particularly for those who intend making a specialty in Geology; its aim is to teach the use of fossils in identifying geological horizons, especially in the North American series of rocks. Students who take this course will be expected to spend some weeks in field-work in the eastern part of the United States.

GEOLOGY 16. — Glacial Geology. — Lectures, conferences, and field-work. Mr. J. B. WOODWORTH.

Course 16 is open to those only who have taken courses 1, 4, and 5, or their equivalents. Courses 2, 8, and 6 also are recommended. Students taking this course must keep one half-day in each week of the autumn free for field-work.

This course treats of the geological work of ice, with particular reference to the glacial period; the glacial theory; the classification, distribution, and age of glacial deposits; their relations to other terrigenous deposits, and to the problems of archaeology, engineering, road-making, water-supply, mason's materials, etc. The field-work affords practice in the determination and mapping of glacial deposits. A few winter excursions will be made to the coast and to other points where the effects of frost are to be observed.

GEOLOGY 22a. — Advanced Geological Field-Work. — Field and library work, with reports, conferences, and theses. Mr. JAGGAR, in coöperation with Professors SHALER, DAVIS, and WOLFF, and Asst. Professor SMYTH.

This course affords a training in the methods of original geological investigation in the field, the preparation of geological maps and reports, and experimental work in the laboratory. It is open to those only who have passed satisfactorily in course 8, and who have studied Mineralogy. Additional experience in field-work such as is acquired in Geology S2, or in the summer work of Geology 10, is desirable, as well as some knowledge of Petrography.

The earlier excursions of this course will be conducted by the various instructors in selected localities, in order to give a systematic review of the geological phenomena of the neighborhood. Individual study of special areas will afterwards be undertaken.

Research in this course is conducted with a view to the publication of the results which may be obtained. During the fall and spring one full day's work each week in the field is required, occasionally under the guidance of the instructor. At the close of each field season, written reports with maps and sections are accepted as the student's record. During the winter the work consists of library research, geological modelling, drawing, map-making, and experimental or field-work upon special problems.

Attendance for oral reports is required on Tuesdays at 4.30, and is expected in the Geological Conference (see page 114) held on Tuesday evenings. Occasional reports, four or five times a year, before the Conference require some special preparation.

GEOLOGY 22b. — Geological Investigation in the Field and Laboratory, under the supervision of Professor SHALER and other teachers of the Department.

This course is intended for students who have already passed in Courses 22a, 10, 16, or 17, or their equivalents, and provides for systematic work leading to results worthy of publication.

The following special topics will, among others, be offered for study during the winter 1897-98: —

Geological Correlation, as illustrated by North American formations; intended especially for students pursuing Stratigraphical Geology. Mr. J. B. WOODWORTH.

Experimental Geology, for students who desire to extend the instruction of Course 17 into original investigation. Mr. JAGGAR.

Attendance at the Geological Conference is expected of students taking this course.

GEOLOGY 27.—Pre-Cambrian Geology of North America: with especial reference to the stratigraphy and economics of the rocks in the original Laurentian area and the region of the Great Lakes. Asst. Professor SMYTH.

Geology 8 and Mineralogy 2 are required as a preparation for Geology 27; and Petrography 12 is recommended.

The object of this course is to give a systematic account of the present state of knowledge of the rocks of the North American continent that are older than the Cambrian. The principal subjects dealt with in the lectures are the actual lithological character of the rocks and their stratigraphical relations, so far as these have been determined, in the various regions in which they have been described; the historical development of opinion regarding their division into groups; and the time relation of these groups in separated areas.

Geological Conference.

The instructors in this department meet the more advanced students in the various courses on Tuesday evenings for the presentation of papers and reports on subjects investigated by the members, with informal comment and discussion by those present. At each meeting there will be one or more leading papers on subjects announced at a previous meeting, and discussion will be directed chiefly to the subjects thus presented. There will be also brief statements of work in progress, and comments on new publications and other matters of interest.

Geological Excursions.

A number of geological excursions to places in the vicinity of Boston will be conducted by the instructors of the department during the fall and spring. They will be open to all students of the University, whether attending geological courses or not. By attending them in order, a general view of the geology of the district may be obtained.

Excursions to more distant localities of interest are generally undertaken by the instructors in the April recess. Students who contemplate the professional study of geology are invited to join these excursions, as they give opportunity for observation that cannot be secured during term-time.

Summer Courses.

GEOLOGY S 1.—Elementary Geology: at Cambridge. Exercises. *Five times a week for six weeks.* Professors SHALER and DAVIS, and Dr. LADD.

An elementary course in Geology, beginning July 6, and lasting six weeks, will be given in Cambridge under the direction of Professor N. S.

SHALER, with the assistance of other instructors of the Department of Geology.

There will usually be two lectures a day on five days of the week. The systematic treatment of the subject will be presented in a series of about thirty lectures, by Dr. G. E. LADD, who will also conduct the laboratory and field-work. Special topics will be treated as follows: Dynamical Geology, by Professor N. S. SHALER; Physiographic Geology, by Professor W. M. DAVIS; Glacial Geology.

GEOLOGY S2.—Advanced course of field-work in stratigraphical geology: at Southern Massachusetts, Rhode Island, and Meriden, Conn. *Six times a week for six weeks.* Professor SHALER and Mr. J. B. WOODWORTH.

This course is open to those who have taken Geology 4 or Course S1, or who possess an equivalent amount of training in Geology. Students intending to take it are recommended to take also Geology 2 and 8 in preparation. It is required as a preparation for Geology 22a, and will be accepted as a preparation for Geology 9 and 15.

GEOLOGY S3.—Training in field research, and in the methods of professional geological field-work, the results to be presented in a thesis: for advanced students. Professors SHALER and WOLFF.

PHYSIOGRAPHY.

GEOGRAPHY 2.—Physiography.* —Lectures, written exercises, laboratory and field-work. Professor DAVIS.

Course 2 is required for students who intend to take Courses 6, 7, and 20; it is recommended to students expecting to take Geology 8, in preparation for the more advanced courses in Geology.

The lectures consider the following subjects:—The form, size, and density of the earth. —Terrestrial magnetism. —The ocean: distribution of water-surface, area, depth, composition, form and deposits of the sea bottom, temperature, waves, currents, tides. —The land:—continental form, plains, plateaus, rivers, lakes, mountains, volcanic forms, coasts, islands; considered in relation to geographical classification and evolution and to their effect on human development. Lantern illustrations will be frequently used.

The laboratory work is directed to the study of charts and models of the ocean basin, charts of ocean temperature, currents, etc.; models,

* In previous years this course has been called Physical Geography.

diagrams, maps and views of various topographic types in different parts of the world. Four field excursions will be made in October and November on Friday or Saturday afternoons. These will give illustrations of a variety of characteristic topographical forms.

GEOGRAPHY 20. — Physiography (advanced course). — Conferences, reports, and theses. Professor DAVIS.

This course is open to those who have passed satisfactorily in Geography 2; ability to read German and French and a general understanding of Geology are desirable. The course may be taken as a half-course in the second half-year by those who have done satisfactory work in Geography 2 in the first half of the same year.

This course is designed to give opportunity for study supplementary to the preceding more elementary courses in Physiography; it will consist of investigation of certain topics selected by the students with the advice of the instructor. Written reports on work accomplished are made by each student. Attendance on the Geological Conference (p. 114) is recommended to students taking this course.

METEOROLOGY.

METEOROLOGY 1. — Meteorology. — Lectures, written exercises, observations, and laboratory work. — Davis's *Elementary Meteorology*. Mr. WARD.

Course 1 is required for admission to the courses in Climatology (Meteorology 19), and Advanced Meteorology (Meteorology 21).

The lectures present the subject under the following headings:— Phenomena of the atmosphere: studies of weather maps; weather-elements, winds, clouds, rain, storms.—Physical phenomena of the atmosphere: temperature, pressure, winds, moisture, precipitation.— Storms: cyclones, thunder-storms, tornadoes.—Geographical meteorology: climate.

The laboratory work consists chiefly in the construction and study of weather maps and meteorological diagrams, the record of meteorological observations, and the examination of climatic charts, with some practice in weather prediction and in the use of ordinary meteorological instruments.

MINERALOGY AND PETROGRAPHY.

MINERALOGY 2. (Formerly Chemistry 2.)—Mineralogy (including Crystallography, Physical and Chemical Mineralogy, and Descriptive Mineralogy). Professor WOLFF, Dr. PALACHE, and an assistant.

Open to those only who take or have taken Chemistry 1. Students proposing to study Petrography are advised to take Course 8 with Course 2.

Text-books: G. H. Williams' *Elements of Crystallography*, and E. S. Dana's *Text-book of Mineralogy*.

The lectures are given at the hours mentioned. The amount of laboratory work necessary for the average student will be about six hours a week. The lectures first take up Crystallography, while the laboratory work is upon the collection of crystal models and natural crystals. An outline of Physical and especially of Optical Mineralogy is then given and illustrated in the lectures by experiments and demonstrations with the polariscope, which students can afterwards repeat in the laboratory. The larger part of the lectures and the laboratory work is, however, devoted to systematic Descriptive and Determinative Mineralogy, which includes the chemical relations of the various species. The lectures are illustrated by specimens from the several collections, while in the laboratory students are taught the various blow-pipe and other chemical tests, which they apply themselves on known and undetermined material. They follow the lectures with the minerals in the collection, and are then given drawers of unknown minerals to determine.

A student who has passed this course should have a knowledge of Mineralogy sufficient for all general purposes; he should be able to identify all but the rarer mineral species. If he wishes to pursue the subject further, he should take up special lines of study. The course is essential for all who wish to go on in Mineralogy or Geology, and is recommended to all those who intend to be chemists. It affords training in observation and inductive reasoning for all engaged in the natural sciences. On this account it is also fitted to form part of a general education.

PETROGRAPHY 3. (Formerly Geology 28.)—Geology and Mineralogy of building stones. Professor WOLFF and an assistant.

This course is intended for architects and for those who specialize in Economical Geology.

The lectures will first describe, in an elementary way, the mineral constituents and geological occurrence of the principal building stones. The

description and classification of the building stones of the United States, quarry regions and methods of quarrying, use in cities; defects and action of the weather, methods of examination and testing will then be treated. The laboratory work will consist in the study of specimens illustrative of the lectures and of occasional visits to quarries and buildings.

PETROGRAPHY 12. (Formerly Geology 12.) — Petrography. — Lectures, laboratory work, and theses. Professor WOLFF and an assistant.

Course 12 is open to those only who have taken Geology 4 and 5, or Geology S 1, and Mineralogy 2. Course 8* is also recommended.

The lectures treat of the structure, composition, classification, origin, geographical distribution, and geological occurrence of the various families of rocks and of the problems of Lithological Geology. The microscopical characters of the rock-forming minerals and the various methods of petrographical investigation in the field and laboratory are included in the course. The work in the petrographical laboratory supplements the lectures and enables students to become familiar with rocks and with practical methods of investigation, and their application to Geology.

PETROGRAPHY 20b. (Formerly Geology 23.) — Petrographical Research in the Field and Laboratory, with lectures and conferences on selected topics. Professor WOLFF.

This course is a continuation of the first course in Petrography. It is established in order to give to advanced students an opportunity to undertake original petrographical investigation.

BOTANY.

BOTANY 1. — General introductory course for undergraduates. Professor GOODALE and Mr. JONES.

This is essentially a comprehensive course. It is designed to present the principles of the Science to those who do not propose to follow it as a specialty, and intended to serve as well as an introduction to further botanical study. The lectures, illustrated by living material, diagrams, photographs, and models, cover the principles of structure, morphology, and classification, together with outlines of the physiology and economics of the higher plants.

The laboratory work, requiring about four hours per week from the average student, is so arranged as to trace the cycle of higher plant life from seed to seed. Every effort is made to emphasize morphological and biological principles as well as anatomical facts. Competent assistants, abundant materials, ample laboratory accommodations, and sufficient appliances, including dissecting microscopes, are provided, and great stress is laid upon this part of the course.

BOTANY 2. — Morphology of Plants. Asst. Professor THAXTER.

Botany 2 is required during the First-Year of the course of four years in Botany and Zoölogy, and is adapted to the needs of those who intend to become professional naturalists or teachers of natural science, or to study medicine. The course is given on Mondays, Wednesdays, and Fridays, from the beginning of the college year until the mid-year, after which it is succeeded by Zoölogy 2. Two or three lectures are given a week; besides attendance on the lectures, the students are required to perform six hours of laboratory work a week on the days above stated. Instruction is given in the method of working with the compound microscope and making microscopic preparations, and a general knowledge of the mode of growth and reproduction in the vegetable kingdom is taught by means of typical plants selected for the purpose.

BOTANY 3. — Principles of the Microscopical Anatomy and Physiology of the Higher Plants; special treatment of problems in Histology, Morphology, and Economics. Mr. JONES.

This course aims to give a training in histological and physiological methods to those intending to become specialists, as well as opportunity for more detailed study to those who wish to follow the subject beyond the first course.

The laboratory course consists in the study of plant tissues, treated from the point of view of development. The elements are studied, first in detail as to their structure and composition, and then as grouped into tissues, and finally the tissues as grouped into organs. In the second half-year each student studies a special topic in such a way as to learn how to apply his knowledge and skill to investigation. Later his topic is given a physiological turn, ending with the practical study of physiological principles.

The laboratories are in all respects fully equipped and always open. The work as planned requires from the average student from six to ten hours per week.

The lectures are two-fold, — first, supplementary to the laboratory work, which they explain in their broader aspects; and, second, a special treatment of related topics in morphology and economics.

BOTANY 4. — Cryptogamic Botany. — Lectures and laboratory work. Professor FARLOW and Asst. Professor THAXTER.

This course is required during the Third-Year of the course in Botany and Zoölogy, and is given on Tuesdays, Thursdays, and Saturdays, from

the mid-year until the final examinations. It is a sequel to Botany 2, and, like that course, consists of lectures and laboratory work, in which the student, if his aim is to prepare himself for teaching botany, is expected to acquire a somewhat detailed knowledge of the Cryptogams applicable to instruction in schools and colleges; or, if his aim is to study medicine, to have an opportunity to familiarize himself with some of the lower forms of plant life which have a bearing on his future medical studies.

BOTANY 20a. — Special advanced and research course. Laboratory study, conferences, and occasional lectures. Professor GOODALE.

This course is intended for higher training in histological and physiological methods and principles, as well as for research work upon problems in histology, physiology, and economics. The laboratory, isolated from those of the other courses, is equipped with apparatus for exact research, and additional appliances are procured when required. A set of working reference books is at hand, and the Herbarium and College Libraries can be freely drawn upon.

There are no regular lectures, but each student's work is under the supervision of one of the instructors, and conferences are held when desirable.

BOTANY 20b. — Advanced course in Cryptogamic Botany. Professor FARLOW and Asst. Professor THAXTER.

This course is intended for the preparation for and prosecution of original research on the subject. The work requires considerable time, and is adapted to students who have reached a stage of their studies where they can with profit attempt special work, having in view the preparation of an original paper on some subject.

Botany 20 may be selected by students of the course in Botany and Zoölogy during the Fourth-Year, but others are not admitted to the course unless they can produce evidence satisfactory to the instructor that they are well grounded in the subjects taught in Botany 1, 2, 3, and 4. There are no formal lectures in this course, and the amount of laboratory work is not definitely fixed, but it should be understood that it is considerable. Each student works independently, and is expected at the end of the year to present a thesis embodying the result of original work. For students in the Scientific School subjects of limited range are selected, since the work must be finished in one year, but the student is required to show by his thesis that he has acquired the power of conducting an original research accurately and scientifically.

ZÖÖLOGY.

ZÖÖLOGY 1. — Zoölogy. — Lectures and laboratory demonstrations.
Dr. C. B. DAVENPORT and assistants.

This course is designed to give a general survey of the whole field of Zoölogy. At the beginning, the structure and activities of the simplest organisms are considered, and then the laws of distribution of animals in space and time, the evolution of the general form, structure, and activities of animals, and the laws of evolution. In Morphology such topics are discussed as the origin of asymmetry and of the metameric condition in animals and the evolution of organs and of tissues. In Physiology are discussed: locomotion, response, nutrition, growth, and development of the individual; the origin of the complicated functions of organs from the simplest condition is also treated of. In considering the laws of evolution certain general topics are taken up; such as, the care of the young, parasitism, symbiosis, coloration, variation, and heredity.

The laboratory work consists of a study of animals selected to illustrate the topics treated of in the lectures.

There are at least two lectures a week, on Tuesdays and Thursdays at 10 o'clock. If there are additional lectures, they occur at the same hour on Saturdays. The laboratory demonstrations require three hours a week, and must be pursued on Tuesdays, Thursdays, or Saturdays.

There are no recitations in this course; but each student is expected to procure Bell ('85).

The following four books are strongly recommended for all students in this course: Claus ('91); Boas ('94); Hertwig ('92); Darwin ('80).

The following books are more extensive treatises, and are especially valuable for those proposing to take more advanced courses: Leunis ('83): Lang ('88-'94); Hatschek ('88-'91); Korschelt und Heider ('90-'93); Verworn ('95); Semper ('81); and Delage ('95).

ZÖÖLOGY 2. — Morphology of Animals. — Lectures and laboratory work. **Dr. C. H. PARKER and assistants.**

This course cannot be taken separately from Botany 2. Exceptions for this rule will be allowed only after written application has been made to, and consent received from, the instructors in Zoölogy 1 and 2 and Botany 2.

The aim of Zoölogy 2 and Botany 2 is to afford the necessary elementary training for those who desire to continue the study of some branch of Natural History, either in the later years of college life or after graduation. Since it is required as a preparation for several other electives, it

should be taken early in the College course; if possible, not later than the Sophomore year; it may be taken, under suitable restrictions, even in the same year with Zoölogy 1.

The lectures in this course are given on Mondays, Wednesdays, and Fridays at 2.30 P.M. The lectures are on the morphology of the more important types of animals; those on a given group follow immediately the corresponding laboratory work, which consists in the dissection of representatives of the types selected. Each student is expected to spend six hours a week in the laboratory, and the hours may be arranged by consultation with the instructor, but they must be on the days named.

Students will find Marshall and Hurst ('96) a valuable aid in connection with laboratory work. The most valuable books for reading and consultation in connection with the course are Lang ('88-'94), and Korschelt und Heider ('90-'93).

ZOÖLOGY 3. — Comparative Anatomy of Vertebrates. — Lectures, laboratory work and reports. Dr. G. H. PARKER and an assistant.

Course 3 is open to those only who have taken Courses 1 and 2 and Botany 2.

This course is intended for those who are particularly interested in Zoölogy, and also for those who wish to lay a broad foundation for their subsequent study of human anatomy as medical students.

Lectures are given at 9 o'clock on Tuesdays and Thursdays, and a demonstration or other informal exercise on Saturdays. In the lectures special attention is given to evidences of progressive modifications in the structure of the organs of vertebrates as exhibited in passing from lower to higher groups.

The laboratory work must be performed on the three days mentioned, and requires at least six hours a week.

The following text-books are recommended: Wiedersheim ('93); Hertwig ('96); and Wiedersheim ('93a).

ZOÖLOGY 4. — Microscopical Anatomy. — Lectures and laboratory work. Professor MARK and Dr. W. McM. WOODWORTH.

Course 4 is preparatory to Courses 5 and 20a. It is open to those only who have taken Course 2, and may be taken advantageously either *after* or with Course 3. It is for those who intend to prepare themselves for making special investigations, either as teachers of Zoölogy, or as physiicians. It presupposes an elementary knowledge of animal morphology, and familiarity with the use of the microscope. As the number of students who can be accommodated is small, preference will be given to those preparing to take Course 5 or 20a.

In this course instruction is given in methods of investigation. There will be two, or, at the option of the instructor, three lectures a week. The laboratory work should be arranged for the morning hours of Mondays, Wednesdays, and Fridays.

The instructors are to be consulted before electing the course.

Students are urged to buy Behrens, Kossel und Schiefferdecker ('89), and Lee ('93). Whitman ('85) and Carpenter ('91) will also be found useful.

ZOOLOGY 5. — Embryology of Vertebrates. — Lectures and laboratory work. Professor MARK and Dr. W. McM. WOODWORTH.

Course 5 is open to those only who have taken Course 4.

The lectures in this course are on the Embryology of Vertebrates. The laboratory work consists in the preparation and study of the chick and other vertebrates at successive stages of development.

Students should procure Foster and Balfour ('83) and Hertwig ('96). In addition are recommended Marshall ('93) and Minot ('93).

ZOOLOGY 20a. — Anatomy and Development of Vertebrates and Invertebrates. Professor MARK.

This course is designed for those only who are competent, with the aid of the instructor, to carry on some original investigation. Each student selects, with the advice of the instructor, the subject of his research, and the results are embodied in a thesis. The investigations of advanced students, when considered worthy of publication, usually appear in the Bulletin of the University Museum.

Persons contemplating this work will find it to their advantage to consult the instructor at an early date, — if possible, as early as the first of April of the preceding academic year.

The Zoölogical Club.

The instructors and advanced students in Zoölogy meet fortnightly for the presentation and discussion of original work and the review of current zoölogical literature.

HYGIENE.

HYGIENE 1. — The Elementary Physiology and Hygiene of Common Life. — Personal Hygiene. — Emergencies. Asst. Professor G. W. FITZ and Dr. BUNKER.

This is an introductory course intended to give the general knowledge of Human Anatomy, Physiology and Hygiene, which should be possessed

by every student; it is adapted not only for those who intend to study Medicine or Physical Training, but also for those who wish to obtain general information on the subject.

HYGIENE 2. — History of Physical Education. Dr. D. A. SARGENT and Asst. Professor G. W. FITZ.

This course is so arranged that the student becomes familiar with the literature of Physical Training and traces the contributions of different times and peoples to the subject. The history of the different sports is traced and the artistic records of the matter studied. The theories of Physical Training are studied comparatively as regards their anatomical and physiological relations, and are discussed in conferences.

HYGIENE 3. — Physiology of Exercise. — Experimental work. — Original work and thesis. Asst. Professor G. W. FITZ.

Course 3 must be preceded by the course in General Physiology at the Medical School or its equivalent.

This course is intended to introduce the student to the fundamental problems of Physical Training, and to give him training in the use of apparatus for investigation and in the methods of such work.

HYGIENE 4. — Anthropometry. — Measurements and Tests of the Body. — Effects of Age, Nurture, and Physical Training. — Lecture and Practical Exercises. Dr. D. A. SARGENT.

Systematic training is given in making measurements and tests of individuals for the purpose of determining their strength and deficiencies. Practice is also given in classifying measurements, forming typical groups and determining the relations of the individual to the group type. This course must be preceded by the course in General Anatomy at the Medical School or its equivalent.

HYGIENE 5. — Applied Anatomy and Animal Mechanics. — Action of the Muscles in different exercises. — Lectures and demonstrations. Dr. D. A. SARGENT.

In this course the muscles taking part in the different exercises and the mechanical conditions under which they act are studied. The body is considered as a machine. The development of force, its utilization and the adaption of the different parts to these ends are especially considered in the work. This course must be preceded by the course in General Anatomy at the Medical School or its equivalent,

HYGIENE 6. — Remedial Exercises. — The Correction of abnormal conditions and positions. — Lectures and demonstrations. Asst. Professor G. W. FITZ.

This course must be preceded by the course in General Anatomy at the Medical School, and by Courses 3, 4, and 5 or be taken with them. Deformations such as spinal curvature are studied and the effects of different exercises observed. The students are trained in the selection and application of remedial exercises, and in the diagnosis of cases unsuitable for such treatment.

PHYSICS.

PHYSICS B. — Experimental Physics. Professor HALL and an assistant.

The laboratory exercises of Course *B* will be given in the morning hours, in most cases from 9 to 11 or from 11 to 1.

Course *B* is substantially equivalent to the second alternative in the Elementary Physical Science of the requirements for admission. It is open to students who have not passed in this requisition or taken in College any course in Experimental Physics.

The object of this course is to enable every student to obtain practical acquaintance with laboratory methods of work and with those elementary facts and laws which are the foundation of the science of Physics. It is for those who have done little or no laboratory work in Physics before coming to College, and is the natural introduction to Courses *C* and 1. Students are advised to take it in the Freshman or the Sophomore year. The book used is Hall and Bergen's *Text-book of Physics*, Holt & Co.

PHYSICS C. — Experimental Physics. — Mechanics, Sound, Light, Electricity, and Magnetism. Asst. Professor SABINE and an assistant.

Course *C* is substantially equivalent to the Advanced Physics of the requirements for admission. It is intended for those who wish to give especial attention to methods of physical measurement in preparation for higher courses in Physics, Chemistry, or Engineering. The course is open to those students only who have presented Elementary Laboratory Physics for admission, or have taken Physics *B* or its equivalent.

The manual used as a guide in the laboratory work is Sabine's *Laboratory Course in Physics*, Ginn & Co.

PHYSICS. 1. — General Descriptive Physics. Professor HALL and an assistant.

Course 1 is intended for students who wish to become acquainted with a wide range of physical phenomena and with the means for exhibiting and applying such phenomena. It is regularly open to students who have taken Course B or who have passed in the second alternative of the Elementary Physics for admission, but may be taken by others who satisfy the instructor of their fitness to profit by the course.

Course 1 is naturally taken by students who do not intend to take any higher course in Physics.

The text-book commonly used is Everett's edition of Deschanel's *Natural Philosophy*, Appleton & Co.

PHYSICS 2. — Light and Heat. Lectures, twice a week, at hours to be appointed by the instructor, and laboratory work in thermometry, radiation, interference, polarization, and spectrometry, six to eight hours per week. Asst. Professor SABINE.

Course 2 is adapted to students making a specialty of Pure Physics.

Members of the class will be asked to provide themselves with Preston's *Theory of Light*.

Students who propose to elect the course should first consult the instructor.

PHYSICS 3. — Electrostatics, Electrokinematics and parts of Electromagnetism. Professor B. O. PEIRCE and an assistant.

Course 3 is adapted to students who take or have taken Mathematics 2 or its equivalent, and should be preceded by Course C or 1.

The course consists of a lecture or recitation every Tuesday, with from six to eight hours of laboratory work per week. In the laboratory the student is expected to learn to make accurate absolute or relative measurements of current strength, resistance, electromotive force, quantity, and capacity. In the second half of the year such a knowledge of the principles of the Differential and Integral Calculus will be assumed as students who are then taking Mathematics 2 should have.

Students who elect this course are asked to provide themselves with S. P. Thompson's *Lessons in Electricity and Magnetism*, Part 2 of the *Physical Laboratory Notes of the Massachusetts Institute of Technology*, Day's *Examples in Electricity and Magnetism*, and a pamphlet published by the University containing a description of certain preliminary experiments in Magnetism. References will be made to other books to be found reserved in Gore Hall.

PHYSICS 4. — Electrodynamics, Magnetism, and Electromagnetism.
Professor TROWBRIDGE, Asst. Professor SABINE, and an assistant.

Course 4 is intended for students who have taken Mathematics 2, or its equivalent, and Physics 3.

This course consists of lectures, recitations and laboratory work. During the first half of the year, the subject of Magnetism and Electromagnetism is treated in lectures with copious references to Wiedmann's *Galvanismus*, and to the unmathematical portions of Maxwell's *Electricity*. During the second half of the year the student is expected to employ the principles of the Differential and Integral Calculus. Some of the mathematical portions of Maxwell's and Mascart's treatises will be referred to, and Fleming's treatise on *Induction and Alternate Transformers* and Ewing's treatise on *Magnetic Induction in Iron and Other Metals* will be used as text-books.

The laboratory work embraces the standard tests of the magnetic quality of iron, the various methods of measuring coefficients of self induction and mutual induction with reversed and with rapidly alternating currents, and other experiments with rapidly alternating currents of low intensity.

Courses 3 and 4 together are intended to cover the subjects of Magnetism and Electricity, and to give a suitable foundation for students who propose to study Electrical Engineering or the higher branches of Electrical Science.

PHYSICS 6¹. — Elements of Thermodynamics. Professor HALL.

Course 6 is adapted for students who have taken Mathematics 2 or its equivalent and are familiar with the elementary facts and principles of Heat. It is intended for beginners, and is especially adapted to the needs of students of Engineering.

PHYSICS 8. — Electromagnetism with especial reference to Periodic Currents. Professor TROWBRIDGE.

This course is intended for Graduate Students; but is open to students who have taken Course 4 and who have no other laboratory course.

PHYSICS 9. — Portions of the Mathematical Theory of Electricity and Magnetism. Professor B. O. PEIRCE.

Mathematics 10 (Fourier's series, Spherical Harmonics and Allied Functions), or its equivalent, will be required as a preparation for Course 9.

Course 9 will use as text-books: Maxwell, *A Treatise on Electricity and Magnetism*, Oxford, Clarendon Press; Webster, *The Theory of*

Electricity and Magnetism, Macmillan; Mascart & Joubert, *A Treatise on Electricity and Magnetism*, London, De la Rue & Co.; Gray, *Absolute Measurements in Electricity and Magnetism*, Macmillan; J. J. Thomson, *Recent Researches in Electricity and Magnetism*, Macmillan; *Heaviside's Papers*, Macmillan; Duhem, *Electricité*, Gauthier-Villars.

CHEMISTRY.

CHEMISTRY B. — Experimental Chemistry. — Lectures or recitations and laboratory work. Dr. TORREY and an assistant.

This course corresponds to the requisition in Chemistry for admission to Harvard College, and the course, therefore, is not open to students who have passed in chemistry at the admission examination. The instruction is given by lectures, followed by laboratory exercises.

The aim of the course is to give a general idea of chemistry, unembarrassed by the multitude of details necessary for a full study of the subject. It deals therefore especially with the principles of the science, and includes in its survey all the different branches of the subject. The teaching is given almost entirely by experiment, in order to give the student an idea of chemical methods. The course is intended especially for those who wish a certain amount of chemistry as part of a general education, and is arranged to cultivate the students's skill in observation and manipulation, as these are especially needed for the complete training of students whose principal courses are of a literary nature. Chemistry *B* serves as a general introduction to all other chemical courses, but a student who intends to make a specialty of chemistry is advised to save time by omitting it and to proceed at once to Chemistry 1, for which no previous training is required. If, however, the student is not pressed for time, he will find Chemistry 1 much easier when preceded by Chemistry *B*. It is advisable therefore to take the school course parallel to Chemistry *B* before entering the University.

CHEMISTRY 1. — Descriptive Inorganic Chemistry. Professor JACKSON and assistants.

In this course each student has each week two lectures on Monday and Friday at 12 in Boylston 9, and either four hours laboratory or, more commonly, two hours of laboratory work and one of recitation. For laboratory and recitation work there are two divisions (to avoid conflicts), the first on Tuesday and Thursday from 1.30 to 3.30, the second on Wednesday and Friday from 2.30 to 4.30. The recitations (one hour) come at 1.30 on Thursday for the first division, at 2.30 on Friday for the second, and when they are held no laboratory work is required on these days. Recitations in Boylston 7, laboratory exercises in Boylston 13.

No previous chemical training is required for Chemistry 1, but some knowledge of the general principles of chemistry will make the work easier for the first month. The course deals with the preparation, properties, and uses of the more important elements and inorganic compounds. The lectures are illustrated by experiments and diagrams and in the laboratory those experiments are performed which are not well adapted to the lecture-room. There is no text-book. A pamphlet entitled *Laboratory Experiments in Chemistry I* is essential; another, *Synopsis of Lectures in Chemistry I*, is useful but not essential.

The course trains the memory, powers of inductive reasoning, faculties of observation, and manipulation. It gives a knowledge of inorganic chemistry sufficient for all the ordinary uses of life, even for men engaged in a scientific profession. It carries systematic instruction for inorganic chemistry as far as is desirable; if a man wishes a fuller knowledge of the subject, he can obtain it by study of the larger text-books much more advantageously than by an additional course of lectures.

CHEMISTRY 3. — Qualitative Analysis. Professor H. B. HILL and assistants.

To be admitted to this course the student must have passed Chemistry 1, or have taken a course of descriptive chemistry equivalent to it.

The amount of laboratory work given in this course will occupy an average worker nine hours each week, three of which must come at the hours given in the programme. The remaining six (or more) hours can come at any time most convenient to the student. At the three required hours the exercises occasionally consist of lectures instead of laboratory work, but there is no work required outside of the laboratory and lecture-room. The text-book is Hill's *Lecture Notes on Qualitative Analysis*.

This course trains the student to draw correct inferences in regard to the composition of substances from a carefully arranged sequence of experiments. It has therefore great educational value, and is also an essential preparation for the more advanced chemical courses. After the analysis of the large number of substances required in this course the student has a training in qualitative analysis suitable for all purposes.

CHEMISTRY 4. — Quantitative Analysis. Asst. Professor RICHARDS and an assistant.

To enter this course a student must have passed in Chemistry 1 and 3, or courses in the same subjects equivalent to these. Students are allowed, however, to take Chemistry 3 and 4 together in the same year. The work in this course is expected to occupy nine or more hours each week, all in the laboratory; three of these hours must come at the times mentioned



in the programme, the remaining work can be done at any time most convenient to the student. The regular hours are occasionally occupied by lectures.

The object of this course is to teach the methods of determining the amounts of each constituent in a substance. It gives a general survey of the more important methods, both gravimetric and volumetric. It has less general educational value than many of the other chemical courses, but is the foundation of all advanced chemical work and therefore essential to those going further in the subject. It also trains the student especially in skill, care and accuracy, and would therefore be useful, but not essential, to those who intend to study medicine or certain branches of natural history.

The laboratory for quantitative analysis is supplied with filter-pumps, steam evaporators, and other modern appliances. The number of balances in the adjoining room is so large that each is assigned to not more than four men.

CHEMISTRY 5.—The Carbon Compounds. Professor H. B. HILL and an assistant.

To enter this course the student must have passed Chemistry 1, or an equivalent course in the same subject; but, although students who have studied only Chemistry 1 are admitted, it is advisable to have a fuller knowledge of Chemistry (3 and 4) before entering this course. The hours named in the programme are occupied by lectures (three each week), and there is required also an amount of work in the laboratory which occupies six hours with an average man. In the lectures a systematic course of organic chemistry is given treating the subject principally from the theoretical side, for, although the applications of the science are described briefly, most of the time is devoted to the description of the preparation and properties of the general groups, and to the elucidation of the structure of the molecules of organic substances, with the methods by which problems relating to the organic constitution are solved. In the laboratory the time is devoted to the methods of organic analysis, and to the preparation of organic compounds. As a general rule the laboratory work of each man is different from that of his fellows, and may be varied to suit his needs or intentions. Students are sometimes allowed to count Chemistry 5 as two courses by giving a larger amount of time to laboratory work, but to do this the consent of the instructor and of the Administrative Board must be obtained.

This course, in addition to cultivating the faculties trained by the other chemical courses, gives practice in reasoning, and in the correlation of a large number of facts by referring them to general principles. It gives a comprehensive knowledge of organic chemistry, and takes the student as

far as is worth while by lectures. Students who wish to pursue the subject further would devote themselves to special lines of study in the chemical journals. It is the essential preparation for research in organic chemistry, and is earnestly recommended to all who intend to make a speciality of chemistry. Candidates for Honors in Chemistry must pass this course. It is useful but not essential to those who intend to study medicine or biology.

The laboratory occupied by the students in Chemistry 5 is fitted with gas, water, steam, and a filter-pump at each desk. The hoods are large and powerful; a sunlight table is provided for work which needs this agent; and attached to the laboratory are a balance-room, a room with the two combustion furnaces, and a room for sealed tube work.

CHEMISTRY 6. — Physical Chemistry. Asst. Professor RICHARDS and an assistant.

The students taking this course after 1895-96 are required to have passed in the following courses or their equivalents: Physics 1 (or *C*), Mathematics *A* and *B*, or Engineering 1*a*, Chemistry 4 and 8. A knowledge of calculus (Mathematics 2) is also very desirable.

The instruction is given by lectures and by laboratory work. In the lectures a complete survey of the subject will be given, including the relations of mass and volume, thermo-chemistry, chemistry of solution, electro-chemistry, and optical chemistry. The laboratory work, which will be arranged to occupy an average man six hours a week, will consist of the study of physical chemistry as related to the subject-matter of the lectures, and will include among similar subjects the determination of the specific gravity of solids, liquids, vapors, and gases; calorimetry; the use of the spectroscope, and the refractometer; boiling and freezing-point determinations; and the study of the conductivity of electrolytes.

Text-books: Nernst, *Theoretical Chemistry* (translated by Palmer), and Ostwald, *Physico-Chemical Measurements* (translated by Walker).

Reference-books: Ostwald, *Grundriss* and *Lehrbuch*.

In addition to the educational value found in the other chemical courses this gives a certain amount of mathematical practice. It is essential for those who take the research course in Physical Chemistry, and is recommended to all advanced students in Chemistry. Candidates for Honors in Chemistry must pass this course.

CHEMISTRY 8. — History of Chemistry, and Chemical Philosophy. Asst. Professor RICHARDS.

This course is required for Honors in Chemistry and for Chemistry 8. It can be taken only by those who have passed in Chemistry 1. It consists of lectures upon the history of the Science, tracing it from the earliest times to the present day, and also gives an account of the present chemi-

cal theories, supplementing the very elementary statements of them contained in Chemistry B and 1. This course should be taken by all who intend to make an extended study of Chemistry. No text-book is required, but the following works will be found useful as books of reference: E. von Meyer, *History of Chemistry* (translated by McGowan); Ostwald, *Grundriss*; Lothar Meyer, *Gründzüge*, and *Modern Theories* (translated by Bedson and Williams); Würtz, *Atomic Theory*; and Scott, *Introduction to Chemical Theory*.

CHEMISTRY 9. — Advanced Quantitative Analysis. Asst. Professor RICHARDS.

CHEMISTRY 10. — Gas Analysis. Asst. Professor RICHARDS.

Students must have passed with credit Chemistry 4 or an equivalent course on the same subject to be admitted to these courses. The amount of time necessary and the arrangement of lectures and laboratory work are similar to those described under Chemistry 4.

The object of these courses is to give the student a fuller knowledge of the more important processes of quantitative analysis. They deal, therefore, with special methods of analysis in the laboratory, but the whole field is covered by lectures. The laboratory work in 9 usually includes the preparation of pure salts, analysis of minerals, iron, waters, and sugar, but may be varied to suit special needs or intentions on the part of the student. Course 10 deals with the analysis of air and other gases. These courses are intended for those who mean to make a specialty of chemistry, and, while useful for all of these, are essential for those who mean to take the course in inorganic research.

The laboratory for these courses is well fitted with modern conveniences. Steam, in addition to gas and water, is brought to the tables and hood; there are filter-pumps and steam evaporators. Not more than four students work with each balance. There is also a workshop with machinery for pulverizing minerals for analysis.

CHEMISTRY 20. — To competent students who have acquired the requisite knowledge and practice, the following are offered as subjects of research under the guidance of the Instructors named: —

- (a) Inorganic Chemistry and Determination of Atomic Weights. Asst. Professor RICHARDS.
- (b) Aromatic Compounds. Professor JACKSON.
- (c) Organic Chemistry. Professor H. B. HILL.
- (d) Physical Chemistry. Asst. Professor RICHARDS.

The courses in research enumerated above are intended to give practice in the methods of solving new chemical problems and in overcoming the

difficulties which arise in such a work. Such practice is of great importance in the training of the professional chemist, and therefore conscientious work in one at least of these courses is a prerequisite for the Doctor's degree in this department; so that a research course should be included in any plan for the professional study of Chemistry. At the laboratories of Boylston Hall and the Mineralogical Museum the Professor will direct advanced students in Chemistry in any special studies or investigations, and these may be planned to meet the needs or tastes of the student whether included under the above heads or otherwise, but the following topics will give an idea of the nature and scope of the work which the several instructors have laid out:—

Course 20 (*a*). The revision of imperfectly known compounds and the investigation of new bodies to which such study often leads. The study of methods of quantitative analysis with a view to the defining of the conditions of accuracy and the improvement of the processes. The discussion of the atomic weights and the more exact fixing of these fundamental values.

Course 20 (*b*). The work in this course lately has consisted in the study of the replacements of bromine or nitrogroups in certain nitrobenzols and of the new compounds thus formed, also in the determination of the constitution of tumerol and curcumine, two substances contained in turmeric.

Course 20 (*c*). The work in this course has been devoted chiefly to an exhaustive study of the furfuran compounds and of the bodies obtained by their decomposition involving both the discovery of new compounds and the discussion of their constitution.

Course 20 (*d*). Any work in chemical physics compatible with a chemical laboratory may be undertaken in this course. Hitherto the work has chiefly consisted in investigations in thermo-chemistry in the study of electrolysis and in the accurate determination of gas density, and for the solution of such problems the laboratories in Boylston Hall have the best facilities.

It is, as a rule, useless for a student to undertake a chemical research unless he is able to bestow upon it the greater part of his thought and energy. The work to be of any value must be engrossing, and necessarily excludes for the time being any other correspondingly engrossing subject. In the scale of college credits research-courses in this department, with the consent of the Administrative Boards, have usually been counted as two or more college courses, and are not practicable for undergraduates in either of the schools on any other basis. No student should undertake a chemical research until he has acquired the knowledge and skill which will enable him of himself to overcome the usual difficul-

ties sure to arise in every such investigation. If he contributes to his teacher's knowledge and ingenuity nothing but manual labor, the work can be of no profit to him, and he had much better be employed on already well-trodden paths in widening his own knowledge and experience. Advanced students who are able to carry forward efficiently chemical investigation are always welcomed at the Laboratories, and the Professors gladly extend to them every facility at their command.

MILITARY SCIENCE.

MILITARY SCIENCE 1. — The Operations of War (organization, tactics, logistics, strategy); Military History; Military Law. — Lectures. — Required reading and reports. Lieutenant ROBINSON (U. S. Artillery).

MILITARY SCIENCE 2. — Military Engineering; Fortification; Ordnance and Gunnery; Electricity in Warfare. — Required reading and problems. Lieutenant ROBINSON (U. S. Artillery).

PHILOSOPHY.

PHILOSOPHY 1. — General Introduction to Philosophy. — First half-year: Logic, and lectures introductory to Philosophical study, by Professor ROYCE. Second half-year: Psychology, by Professor JAMES. — Jevons, *Lessons in Logic*; James, *Psychology* (Briefer Course). The Assistant in this course is Dr. RAND.

Course 1 is intended as preliminary to the higher courses.

The intention of this work is to explain to beginners the meaning and interest of philosophical study, and to give to those who take the course an elementary acquaintance with at least two important branches of Philosophy. The method of instruction will be by lectures. A text-book (as announced above) will be used in connection with each subject. In addition to the examinations, ten-minute questions will be answered in writing once or twice a week.

PHILOSOPHY 2. — Experimental Psychology. — Lectures, laboratory exercises, and special topics treated in conferences and theses. Professor DELABARRE (of Brown University) and Mr. LOUGH.

Philosophy 2 is intended for those who have a more individual aptitude for Psychology, or who are tempted to pursue the subject in a professional

spirit or with professional aims. Each student has for the theoretical part of his work to write a substantial thesis on some special psychological question. The practical part of his work will consist of a systematic course of laboratory exercises, comprising the dissection of the brain, the fundamental facts of sensibility, and the use of certain important methods and instruments. It is hoped that selected students of this course may be admitted to take part in some of the graduate investigations of the laboratory.

PHILOSOPHY 16. — The History of Educational Theories and Practices. — Lectures, discussions, and reports. — Two essays. Asst. Professor HANUS.

The object of this course is to make the student acquainted with the educational aims and practices of the past and with the most important educational classics, and thus enable him to obtain a foundation for the criticism of present theories and practices in the light of their historical evolution, and, incidentally, to acquire many rules for guidance in the actual work of teaching.

Education in Greece, Rome, and during the Middle Ages will be briefly considered. Most of the year will be devoted to the history of Education and Teaching since the Renaissance in Europe, and some time will be given to the history of Education and Teaching in the United States. Two essays are required and a course of reading is prescribed.

PHILOSOPHY 17. — Organization and Management of Public Schools and Academies. — Supervision, Courses of Study, and Instruction. — Lectures, discussions, and reports. Asst. Professor HANUS.

The aim of this course is to enable students to become familiar with and to understand the organization and administration of schools and school systems through direct observation and comparative study. In studying the school systems of American cities, a detailed examination of their courses of study will be undertaken, and the principles on which any course of study should be based will be discussed. The duties of superintendents, principals, and teachers will be considered. Attention will be given to details of school management, such as the management of classes, examinations and promotions, discipline; and some attention will be given to methods of teaching the elementary subjects. During the year students will observe, under direction, the work of public schools and academies in the vicinity of the University. Each student will make a comparative study of the teaching in all the grades of at least two schools.

Reports of this work, written when required, will be submitted weekly. For fuller discussion of these reports, and for consultation, a third hour may be arranged by the instructor. Students are also expected to make themselves acquainted with the mode of directing any supplementary activities of the schools they study, such as the work of literary and scientific societies. A course of reading is prescribed. At the end of the year, each student will submit a thesis on the organization of a city school system, in which special attention will be given to the course of study, together with directions for its rational and effective administration. In this thesis the student will be expected to treat particularly his own specialty, for which all the details of the course of study, the teaching resources, and methods of teaching, must be fully considered.

If time permits, one or two state school systems and the school systems of England, France, and Germany will be briefly considered.

PHILOSOPHY 18. — Introduction to Educational Theory. — Discussion of Educational Principles. — Lectures, reports, and discussions. — One essay. Asst. Professor HANUS.

The aim of this course is to enable the student to attain the conception that Education is a rationalized endeavor rather than a mere routine, and to make a critical examination of such generally accepted educational principles as may serve to guide the student in his further study of educational questions. The meaning and scope of Education are defined, and its aims, means, and methods are examined. The special aims and general method of elementary and secondary education are treated separately and also in relation to each other. The following topics indicate the general character of the work: General Principles of Education, including the Scope and Meaning of Education; the Relation of Psychology to Educational Theory and Practice; the Development of the Individual; the Special Aims of Elementary and of Secondary Education; Educational Values and Courses of Study; the Correlation of Studies; General Principles of Method; the Bearing of Instruction on Character; the Study of Children; Discipline and Moral Training; School Hygiene. The remaining time will be devoted to a study of selected educational literature. A course of reading is prescribed, and an essay is required.

PHILOSOPHY 19a. — Methods of teaching Mathematics, Physics, Chemistry, Physical Geography, Botany, Zoölogy, Physiology, in Elementary and Secondary Schools. About ten exercises in each subject. Asst. Professor HANUS and others.

It is expected that Courses 19a and 19b will be given in alternate years.

PHILOSOPHY 19b. — Methods of teaching Latin, Greek, English, German, French, History, in Elementary and Secondary Schools. About ten exercises in each subject. One thesis on the work of the whole course. Under the direction of Asst. Professor HANUS.

The instruction in Courses 19a and 19b will be given by college teachers and by persons engaged in teaching in secondary schools.

The aim of these courses is to acquaint the student with the planning and the conducting of class work under the conditions existing in public schools and academies, together with the teaching resources in each subject. The thesis required of each student must comprise a discussion of the general principles involved in the teaching of science for Course 19a and of languages for Course 19b, and must also comprise for each course a special discussion of the methods of teaching those particular subjects in which the student is especially interested.

The Department of Education and Teaching is solely responsible for the instruction in Courses 19a and 19b.

PHILOSOPHY 20g. — Pedagogical Seminary. — *Subject for the year:* The Aims, Organization, Equipment, and Methods of Education; more particularly of Secondary Education. — Lectures, essays, reports, and discussions. Asst. Professor HANUS.

This course is intended only for the most advanced students. At the outset a general survey of present problems in education, based on the Report of the Committee of Ten and the Report of the Committee of Fifteen, will be undertaken. Such problems include questions of Educational Values; the Correlation of Studies; the Order and Distribution of the several subjects and the time to be assigned to them in the Course of Study; the Methods of Teaching these subjects; the Organization of Schools and School Systems, and the Proper Equipment for Effective Work. Soon after the Seminary is organized, each member is expected to select some topic or topics for special study, and later to present the result of this study to the Seminary in the form of at least one essay during each half-year. Much stress is laid on the essays and the discussions based on them. Each member of the Seminary will also be expected to make a special report on the bibliography of that part of the field of Education in which he is especially interested.

ARCHITECTURE.

ARCHITECTURE 1a. — Technical and Historical Development of the Ancient Styles, with special reference to Classic Architecture.
— Lectures and practice in the drawing-room. Asst. Professor WARREN.

This course is open to students in the College who have taken both Fine Arts 1 and Fine Arts 2, and who have obtained at least Grade C in both courses.

The first few weeks of the course will be devoted to gaining facility in the simple representation of architectural form, with some study of the elementary principles of projection and perspective drawing and shades and shadows. The history of ancient architecture will then be taken up. The gradual development of architectural forms and the technical processes of building will be traced, beginning with a summary study of the buildings of Egypt, Assyria, and Persia, and passing on to the more thorough and detailed consideration of the architecture of Greece and Rome. Students will be required from time to time to make drawings and written reports in illustration of the lectures. During the course the elements of Classical architectural form, especially the Greek and Roman orders, and their uses will be considered. The more important buildings will be examined in detail, and the structural and aesthetic principles on which their design depends will be critically studied. The course will be so conducted as to make the greatest possible use of the library to familiarize the student with books and their use. The course is not merely historical, but aims to lay the foundation of a working knowledge of architectural form and thus serves as an introduction both to Course 1b and 1c, which continue the history of architecture, and to Course 4a, which begins the study of architectural design. The courses is history include a study of ornament and of the principles of ornamental design.

N. B. — The ability to use French and German reference-books with ease will be found valuable, though not essential.

Reference-books: Reber, *History of Ancient Art*; Perrot and Chipiez, *History of Art in Ancient Egypt; — in Chaldaea and Assyria; — in Persia*; Maspero, *Egyptian Archaeology*; Babelon, *Manual of Oriental Antiquities*; Laloux, *l'Architecture grecque*; Durm, *Die Baukunst der Griechen*; Durm, *Die Baukunst der Etrusker und Römer*; Martha, *l'Archéologie étrusque et romaine*; Choisy, *l'Art de bâtir chez les Romains*; Bühlmann, *Die Architektur des classischen Alterthums und der Renaissance*.

ARCHITECTURE 1b. — Technical and Historical Development of the Mediaeval Styles of Architecture. — Lectures and practice in the drawing-room. Asst. Professor WARREN.

ARCHITECTURE 1c. — Technical and Historical Development of the Renaissance and Modern Styles of Architecture. — Lectures and practice in the drawing-room. Asst. Professor WARREN.

Course 1c will be omitted in 1896-97. Courses 1b and 1c are given in alternate years, and are taken by the Second and Third-Year men together; so that one set of students, following the chronological order, continues the studies of the First-Year, which close with the decline of Roman art, by taking up in the Second-Year the study of the Mediaeval art which grew out of that decline, and completes the history of architecture in the Renaissance and Modern styles; while another set of students passes from Roman architecture to its revival in the fifteenth century, and goes back to study the Mediaeval styles.

In these courses the study of the history of architecture will be continued by means of lectures and the making of drawings and written reports by the students illustrative of them. There will be the same insistence on the acquirement of familiarity with the forms that are met with, and their proper use. From time to time special subjects of research will be given out which the students will be expected to investigate for themselves, under guidance, by means of engravings and photographs, and upon which written reports will be required.

In the latter part of the year a series of lectures will be delivered on the history of ornament with practice in decorative design.

The endeavor will be to study the history of architecture not so much archaeologically as in a more vital way with reference to actual practice; to obtain a knowledge of principles of design by an analysis of the growth of architectural form and its use; regarding the buildings that are studied not as objects of contemplation or as historical documents, but as examples of various methods of work carried out under certain conditions; to study architectural form and composition by means of the history of architecture; to study, in short, not merely styles but style.

Reference-books: In Course 1b — Essenwein, *Die Ausgänge der classischen Baukunst*; Essenwein, *Die Fortsetzung der classischen Baukunst im oströmischen Reiche*; Choisy, *l'Art de bâtir chez les Byzantins*; Bayet, *l'Art byzantin*; Dehio und v. Bezold, *Kirchliche Baukunst des Abendlandes*; Moore, *Development and Character of Gothic Architecture*; Viollet-le-Duc, *Dictionnaire raisonné de l'architecture française*; Chateau, *l'Architecture en France*; Parker, *Introduction to the study of Gothic Architecture*; or *A B C of Gothic Architecture*; Paley, *Gothic*

Mouldings. In Course 1c—Burkhardt, *Geschichte der Renaissance in Italien*; Der Cicerone; Lübke, *Die Renaissance in Frankreich*; *Geschichte der deutschen Renaissance*; Palustre, *L'Architecture de la Renaissance*; Muentz, *Histoire de l'Art pendant la Renaissance*; Symonds, *Renaissance in Italy*.

ARCHITECTURE 2a.—Elementary Architectural Drawing. Asst. Professor WARREN, Messrs. NEWTON and FOX.

This course is illustrative of Course 1a, and is open only, except by special permission, to those students who are taking Course 1a in the same year, and must be taken by all who are taking Course 1a, unless exempted by special permission.

The drawing-room is open to students from 9 A.M. to 9 P.M. An instructor is usually present during the day-time. Students of architecture in their First-Year should give all their spare time to their drawing. After some preliminary work the time is devoted to making a series of long and carefully rendered drawings of simple buildings, or portions of buildings, and of standard examples of each of the orders. This not only gives the necessary practice in draughtsmanship, but familiarizes the student with the best forms of the orders. Students are encouraged to make their own selection of the examples to be drawn, subject to the approval of the instructors. The drawings form in effect a series of illustrations to the lectures in Course 1a. An exhibition is made of each series of plates as completed, and the work is then criticised before the class.

ARCHITECTURE 2b.—Descriptive Geometry, Shades and Shadows, Stereotomy, Perspective. Mr. TILDEN.

The practice the student has had in his First-Year in Course 2a enables him in the Second-Year to take up the thorough study of Descriptive Geometry, Shades and Shadows, and Perspective, with the interest and intelligence that comes of realization of the application to be made of them, and the study is made easier by the practical experience already gained.

That part of the course relating to Descriptive Geometry undertakes to explain the laws of graphical projections, which are necessary to the representation of architectural design, and especially to lead to the study of conventional Shades and Stereotomy. It includes problems in the projection and representation of points, lines, surfaces and solids under various conditions or from different points of view arising from changes in the position of the spectator or of the object itself; also problems on

the intersection of lines, planes and surfaces of revolutions and problems involving the measuring or the construction of plane and diedral angles and of distances between points, lines and planes.

The work in Shades and Shadows and Stereotomy is the continuation and application of the study of projections, and more particularly of the problems on intersecting surfaces. In the former the tedious and mechanical method of searching for a number of points in the outline of shadows is obviated by methods of finding directly, and without the use of the plan, principal points of the outline; such, for instance, as the beginning and end, or the highest and lowest points. In the latter the more complicated problems in joinery, now entirely obsolete in this country, are omitted, and the course confines itself chiefly to problems in stone-cutting, including flat, cylindrical, and elliptical vaults, either with or without penetrations by other vaults of equal or less height.

The study of Perspective does not depend directly upon that of Descriptive Geometry, and may be undertaken quite independently. It is believed that a thorough understanding of the limited number of principles with which it is concerned is of the highest value, and the course endeavors to set forth these principles, requiring at the same time their application in a certain number of practical problems.

ARCHITECTURE 3a. — Freehand Drawing from Architectural Subjects. Asst. Professor WARREN and Mr. NEWTON.

This is a course for practice in drawing especially arranged for students of architecture, in continuation of Fine Arts 1. It includes practice with pencil, pen, and brush, giving the student a careful training in the simplest method of expressing an architectural subject, whether a fragment of detail or a building. The simple direct line of Bourgerel and other French draughtsmen of his day has been found to bring encouraging results, leading to firmness of touch and handling.

ARCHITECTURE 3b. — Freehand Drawing from Architectural Subjects (second course). Asst. Professor WARREN and Mr. NEWTON.

In this course the student is permitted more freedom, and individuality in the handling of his subject is encouraged. The works of the best draughtsmen are put before him, and after the severer training of the preceding course he may treat his subjects in his own way under the direction of the instructor, always with a view to producing a pleasing composition in light and shade, as well as in form.

ARCHITECTURE 3c. — Freehand Drawing from Architectural Subjects (third course). Asst. Professor WARREN and Mr. NEWTON.

Especial attention will be given in this course to the composition of drawings, which is not only essential to the artistic presentation of architectural subjects, but is of great aid in cultivating the sense of composition in architectural design, which depends upon the same principles. Studies principally from Turner, Harding, Cotman, and Claude Lorraine will be carried on. In a measure this course will be a resumé of Fine Arts 1, putting into practical use the principles there taught and familiarizing the student with the works of the masters best illustrating them. In the latter part of the course instruction will be given in figure drawing, the casts in the Fogg Art Museum from the antique and from mediaeval and renaissance masters being used as models.

These courses give the necessary daily practice in freehand drawing, which alone will enable the student of architecture to obtain the knowledge of form and facility in its representation which an architect needs. Instruction is given in the use of pencil, pen, and water-colors. Work will be done from the flat and from the round. The increasing collection of examples of good draughtsmanship, which the department possesses, and the photographs and casts will be used as models. Nearly all the work will be done from architectural subjects, so that the student may be adding to his store of knowledge of architectural form at the same time that he acquires mastery of his hand.

ARCHITECTURE 4a. — Elementary Architectural Design. — Lectures and practice. Asst. Professor WARREN and Mr. NEWTON.

This course is open to those students only who have passed satisfactorily in Course 1a and 2a, or satisfy the instructors that they have done equivalent work, and who are taking Courses 3a and 1b or 1c in the same year. *All the courses in design will require the student to devote all the time he can possibly give to the work.* The hours given indicate merely the time when the instructors will certainly be present, and the hours upon which lectures will fall when they are given. The drawing-room is open from 9 A.M. to 9 P.M., and an instructor is usually present in the day-time. During the first weeks of the course the student will be occupied in making carefully-rendered drawings of standard examples of architectural composition and in weekly exercises in design from dictation; in this way the memory and imagination of the student will be stimulated and the knowledge of form acquired during the first year will be made use of and fixed in the mind. Following this introduction the study of architectural design will be farther pursued (1) by means of

occasional lectures on the principles of design and of planning, and (2) by means of problems of an elementary nature, which will be given out from time to time as exercises in original composition. These designs will be carefully elaborated under the constant direction and criticism of the instructors, and when completed will be criticised before the whole class.

ARCHITECTURE 4b. — Architectural Design (second course). Asst. Professor WARREN and Mr. NEWTON.

This course is open to students who have passed satisfactorily in Course 4a of which it is a continuation.

As in the previous course the work will be carried on by means of problems and criticisms, and occasional lectures. The study of planning will be taken up systematically, and lectures will be delivered on the right artistic treatment of the various materials used in building.

In the work in design the forms of classical architecture will be mainly used, as the object of the course is to give a mastery of technique and of composition, and this can better be done by endeavoring to secure as complete a mastery of one style as the limited time of the course will allow, rather than by scattering the energies in an impossible attempt to secure adequate knowledge of several styles. For this purpose the classical styles are preferred because of the simplicity of their fundamental forms and because these forms lie at the foundation of all modern styles. The problems proposed in the courses on design will be selected with a view to stimulating as far as possible whatever imagination or poetic feeling the student may possess at the same time that they give practice in various classes of architectural composition. In the main they will be such as depend upon present American conditions: not merely conventional school problems without relation to our time or civilization.

ARCHITECTURE 4c. — Architectural Design (advanced course). — Lectures and practice. Asst. Professor WARREN and Mr. NEWTON.

This course is open to students who have passed satisfactorily in Course 4b. During the first half of the year the lectures given will be devoted mainly to a consideration of the requirements and planning of modern buildings: such as schools and other educational institutions, museums, public libraries, railroad stations, town halls, theatres and concert halls, commercial and domestic buildings. Several problems in the design of such buildings will be given out. A number of lectures will be given in connection with this course on landscape gardening in its relation to architecture. The method of instruction will be the same as in the previous course.

The second half of the year will be devoted to thesis work.

FINE ARTS.

FINE ARTS 1. — Principles of delineation, color and chiaroscuro. — Lectures (once a week) with collateral reading. — Practice in drawing and in the use of water-colors. — Perspective. Professor MOORE.

This is a course on the theory of the graphic arts as modes of expression. It at the same time includes the study of nature from an artistic point of view, and aims to cultivate the eye, and in some measure to train the hand. The instruction is given by lectures and collateral reading and by practice in drawing with the point and in water-colors. In the drawing and coloring exercises the theoretic aim of this course is kept steadily in view. These exercises serve to fix in the mind of the student the fundamental principles of graphic art, and for the student of architecture a solid foundation is laid for the continued practice in freehand drawing which is to follow.

The books chiefly referred to will be the following: — Ruskin's *Modern Painters* and *Elements of Drawing*; Longfellow's *Abstract of Lectures in Perspective*; Sir Joshua Reynolds's *Discourses*; Hammerton's *Thoughts about Art*.

FINE ARTS 3. — Ancient and Mediaeval Art. Professors NORTON and MOORE.

FINE ARTS 4. — Roman and Mediaeval Art. Professor NORTON.

Courses 3 and 4 in the Department of Fine Arts are devoted to the history of these arts from the earliest times to the seventeenth century of our era. In Course 3 the general characteristics of the arts of Egypt and Assyria are treated, but special attention is given to the development and principles of Greek art with reference to its importance as an illustration of the life and Spirit of the Greeks, in connection with the other forms in which their genius showed itself, and with the events of their political history.

Course 4 deals in a similar manner with the architecture, sculpture, and painting of the Romans, of the Middle Ages, and of the Renaissance.

These courses are given in alternate years.

GREEK AND LATIN.

GREEK 10. — The Life of the Ancient Athenians, described and illustrated by the aid of the Literature and of the Monuments.
Professor WHITE.

The courses Greek 10 and Latin 10 are made part of the four years' course in Architecture in order that the student may understand the civilizations out of which grew the fundamental forms of his art, and may realize the connection existing between these forms and the life which they expressed.

Greek 10 will be given alternately with Latin 10. It is intended both for classical students and for others who have not been able to devote special attention in college to the classics, but who may nevertheless wish to make a systematic study of old Greek life. The ability to read Greek and Latin and to use German and French works of reference is desirable but is not required. The instructor will explain in an elementary way, but systematically, how the ancient Athenians lived. He will describe, for example, their houses and how they were furnished; their dress, coverings for the head and feet, and personal ornaments; their system of education; their marriage and funeral rites, entertainments, in-door and out-door sports, markets, shops, exports and imports; the trades and professions among them; their country life; their means of conveyance; how the ship was constructed, manned, and rigged; how the horse was bridled and harnessed, etc., etc. The lectures will be illustrated as fully as possible by means of diagrams, casts of works of ancient art, books on art, and the stereopticon, which is provided with over a thousand slides. Lectures will be given on Tuesdays and Thursdays; Saturdays will be devoted to illustration by means of the stereopticon and to collateral reading.

The course is given by lectures, but members of the class will be required to prepare for examination parts of the books named below, and occasionally also parts of other English books of reference. Of these the instructor will give some explanation and description at the first lecture. No collateral reading will be required in any other language than English; but the instructor will give references also to valuable works written in German and French for the benefit of those who can read these languages. All the books to which reference is made will be reserved for the use of the class in the Library of the Classical Department. Each member of the course will be required to write two short theses, involving elementary investigation.

Reference Books: Smith, *Dictionary of Antiquities* (third edition in 2 vols., 1890, Little, Brown & Co., Boston, \$7 each vol.); Guhl & Koner,

Life of the Greeks and Romans (Appleton & Co., New York, \$2.50), or preferably the German edition under the title, *Das Leben der Griechen und Römer* (Weidmann, Berlin, M. 18); Blümner, *Home Life of the Ancient Greeks*, translated by Alice Zimmern (Cassell & Co., London, \$2), or preferably the German edition the title, *Leben und Sitten der Griechen* (Frytag, Leipzig, M. 4.80).

LATIN 10. — The Private Life of the Romans, chiefly as illustrated by works of art. — Lectures, with collateral reading. Professor GREENOUGH.

Latin 10 is given alternately with Greek 10.

This course, of the same grade and conducted in the same general way as Greek 10, is intended to give to classical students and others (see description of Greek 10) by lectures and the stereopticon, as complete a representation as possible of Roman private life. The equipment for this purpose includes the best illustrated works on classical antiquities, which are accessible to the student in the library of the Department or in the University Library, and about a thousand stereopticon slides. In addition to the examinations each student will be required to make a certain number of reports on special topics in a somewhat more minute way than the same topics can be treated in the lectures.

ENGLISH.

ENGLISH A. — Rhetoric and English Composition. — A. S. Hill, *Principles of Rhetoric* (revised and enlarged edition), and parts of the *Foundations of Rhetoric*. Lectures, written exercises, and conferences. Professors A. S. HILL and BRIGGS, and Messrs. HURLBUT, COPELAND, ROBINSON, COBB, DUFFIELD, HART, NOYES, LA ROSE, and COTTON.

Course A gives elementary instruction in the theory and the practice of English Composition. The theory of composition is taught throughout the year by lectures based on A. S. Hill's *Principles of Rhetoric* (revised and enlarged edition) and *Foundations of Rhetoric*, and by oral and written exercises; the practice is obtained in short themes, written in the class-room and criticised by the instructors.

For the writing of themes the class is divided into six sections, which meet the instructors and write themes in the class-room on Wednesdays or Thursdays. These themes are read and criticised in detail by the instructors. They are then returned to the writers in person, at hours corresponding to those at which they were written; and they are generally rewritten on the spot, with the instructor's criticism in view. For the

personal conferences and the rewriting of themes, each of the six sections is subdivided: for the rewriting there are twenty-four sections; for the conference, forty-eight.

For the study of Rhetoric each of the six sections is subdivided into four parts.

ENGLISH B. — English Composition. — Twelve Themes. — Lectures and discussions of themes. Asst. Professor WENDELL and Messrs. ABBOTT and COTTON.

Course *B* is prescribed for Sophomores who, having passed in Course *A*, take neither Course 31 nor Course 22. It is open to those students only who have passed in Course *A*.

Course *B* gives, together with general instruction concerning the elements and qualities of English style, some practice in Exposition, Description, and Narration. Wendell's *English Composition* is used as a text-book.

This class is divided into three sections, each in charge of a separate instructor. On Tuesdays lectures are given, dealing during the first half-year with the principles of Expository writing, and during the second half-year with those of Descriptive and Narrative. These lectures are illustrated by the reading of themes written in the course. Knowledge of the lectures may be tested by hour examinations.

For the meetings on Thursdays, each of the three sections is divided into five or six parts, one of which meets the instructor for personal conference each week.

Every theme is read by one of the instructors, who holds himself ready, during office-hours which will be duly announced, to discuss with the writer any question that may arise concerning the work in hand. Every student is expected thus to discuss his work with his instructor. The themes, with written criticisms, are handed back to the writers. They are then carefully corrected, rewritten if necessary, and finally returned to the instructors.

ENGLISH BC. — English Composition. — Written exercises and conferences. Messrs. HURLBUT, HALL, and HAPGOOD.

This course, which corresponds in part to Course *B* and in part to Course *C*, is prescribed for students in the Lawrence Scientific School; it is open to those only who have passed in Course *A*.

Course *BC* cannot be counted towards the degree of A.B., except with the permission of the Deans of the College and the Scientific School.

Course *BC* gives instruction in Descriptive, Narrative, Expository, and Argumentative writing. The subjects are connected with the student's work in the Lawrence Scientific School.

ENGLISH C. — English Composition. — Forensics. — A brief based on a masterpiece of argumentative composition. Three forensics, preceded by briefs. Lectures, class-work, and conferences. Asst. Professor BAKER, and Mr. HALL, and assistants.

Course *C* is prescribed for Juniors who have passed in Course *B*, Course 31, or Course 22, and who do not take Course 30. It is open to those students only who have passed in Course *B*, Course 31, or Course 22.

Course *C* gives practice in Argumentative Composition. Baker's *Principles of Argumentation* is used as a text-book.

At the opening of the College year arrangements are made for enough sections to allow the class to meet from October to Christmas in groups of forty to fifty. In the class-room there are talks on the principles of argumentation, and exercises to test the student's knowledge of these principles. Class-room work ends at the Christmas recess.

The questions proposed for discussion in Forensics are so distributed among the different Departments that by a proper choice of topics students may bring their work in this course directly into relation with their work in other courses. Students are expected, in every case, to treat their chosen topic so that the resulting essay may be intelligible to a general reader.

For one hour on each working day of the week an instructor in the course will be present for consultation in Sever 10.

Each forensic is to contain at least 1000 words and not more than 1500. It is read by one of the instructors, and is generally dealt with like the themes in English *B*. Like these themes, all forensics are to be carefully corrected, rewritten if necessary, and finally returned to the instructors.

Fuller information as to the forensic work will be found in the *Announcement Concerning Forensics*, published and distributed at the beginning of the academic year. Every student is required strictly to observe the Rules of the Course, printed in this *Announcement*.

ENGLISH 22. — English Composition. Asst. Professor GATES, and Mr. ABBOTT, and assistants.

Course 22 is similar to Course 31, except that it is open to those only who have attained Grade *C* in Course *A*. It is counted as the equivalent of Course *B* and a half-course of elective study.

Course 22 is intended for Sophomores who, having attained a fair measure of technical proficiency in English Composition, wish, while perfecting their technique, to have practice and guidance while dealing with

distinctively literary problems. The lectures take for granted a thorough understanding of the elements of style,—the word, the sentence, the paragraph,—and have to do chiefly with questions of method, form, tone, and effect. Four kinds of writing are discussed with special care,—Description, Narration, Exposition, and Argument. Selections from standard authors are analyzed in the class-room to illustrate peculiarities of method and the precise correspondence between methods used and effects obtained. Class-room discussion is encouraged. The aim of the course is to combine practical drill in composition with theoretical training, and to give the student at one and the same time skill in writing, command of principles, and an insight into literary methods and effects.

The written work of the course consists of sixteen fortnightly themes and one hundred daily themes. The fortnightly themes are criticised in detail, and also as wholes with reference to structure, tone, methods, and effects. The last six fortnightly themes deal connectedly with a single subject. The daily themes give continuous life to the course and develop quickness of observation, readiness of expression, and sensitiveness to literary effect.

There are conferences at which attendance is required.

GERMAN.

GERMAN A.—Elementary Course.—Grammar.—Translation from German into English, and elementary exercises in translating into German. Mr. NICHOLS, Dr. BIERWIRTH, and Messrs. HOWARD, J. A. WALZ, and W. E. WALZ.

Course A is equivalent to the Elementary German of the admission requirements, and is prescribed for Freshmen who did not present German in the examination for admission, and do not elect Course B.

The principal aim of Course A is to give the student a knowledge of German sufficient to enable him to read easy German at sight and translate simple English sentences into German. Special attention will also be paid to systematic training in pronunciation. The selections for reading will be made from the easier writings of German authors, chiefly in prose. Practice will be given in committing to memory brief extracts in prose and poetry.

GERMAN 1c.—German Prose.—Subjects in Natural Science.—Reading at sight. Dr. BIERWIRTH.

This course is intended to furnish drill in the reading of modern scientific German, and is recommended to students who are taking, or who plan to take, special courses in Natural Science or in Medicine. An

elementary knowledge of at least two of the Natural Sciences is requisite for success in this course. Dippold's *Scientific German Reader* will be used as an introduction, and will be followed by monographs on various subjects, in order to give the student as large a vocabulary as possible. In the academic year 1895-96 the following books were used: Cohn's *Ueber Bakterien*; Klein's *Anorganische Chemie*; Wunschmann's *Die Röntgen'schen X-Strahlen*. Among the books to be read during the year 1897-98 are: Cohn's *Ueber Bakterien*; Müller's *Die Elektrischen Maschinen*; Helmholtz's *Ueber Goethe's Naturwissenschaftliche Arbeiten*.

FRENCH.

FRENCH A. — Elementary Course. — French Prose and Composition. MESSRS. WRIGHT and LA MESLÉE.

There will be at least three sections in this course, but all sections will be examined in Group XII. The choice of sections, by students who have no conflict with an elective course, will be subject to the approval of the instructor.

This course is equivalent to the Elementary French of the admission requirements, and is prescribed for Freshmen who have not presented French at the examination for admission.

The object for this course is to prepare students to follow the more advanced courses, but it may be taken by those desiring simply to acquire a fair reading knowledge of French. The work consists largely of translation from French into English, of sight-reading of simple French, and of translation from English into French, the exercises illustrating the elementary rules of grammar and the simpler rules of syntax, which are required to facilitate sight-reading of simple French prose. In the course of the second half-year connected passages of translation from English into French, short and easy summaries, in French, of passages from the books read in class, and easy dictations in French, form an important part of the work.

The following books will be used: Chardenal's *Complete French Course* (Allyn & Bacon); Ludovic Halévy, *l'Abbé Constantin*; Dumas père, *la Tulipe noire*; Belot et Villetard, *le Testament de César Girodet*; George Sand, *la Mare au Diable* (Heath & Co.); Voltaire, *Histoire de Charles XII*; Emile de Bonnechose, *Bertrand du Guesclin* (Macmillan & Co.). The English language will be used so far as is necessary to enable students to clearly understand explanations. At the final examination the student will be expected to have a knowledge of elementary French grammar, to be able to translate at sight a passage of ordinary French prose, and to write an easy French composition.

FRENCH 1b.—French Prose, historic and general. **MESSRS. BABBITT and FORD.**

Open to students who have passed in Course A, or have passed the admission examination in Elementary French.

This course is conducted in English.

Course 1b is designed primarily for those who do not intend to enter subsequently the more advanced French electives, and, at the same time, who wish to acquire a reading knowledge of French sufficient to enable them to use it as an instrument in connection with other studies. Composition will be studied only in so far as is necessary to insure accuracy and closeness of grasp upon idiom, and will be confined to dictation and easy exercises in translation from English into French, not requiring preparation outside the class. In addition to the regular reading, each student will be expected to do during the year—preferably in connection with one of his other electives—outside reading to the extent of a thousand pages, or about four average volumes. Lists of recommended books in History, Political Economy, and other subjects, will be furnished by the instructor; one only of the volumes thus chosen may be in fiction.

The following books will be partly read, partly translated: Dumas, *les Trois Mousquetaires* (Ginn & Co.); Taine, *les Origines de la France contemporaine*: Extracts (Holt & Co.); George Sand, *la Petite Fadette* (édition Bôcher, Holt & Co.); Thiers, *Expédition de Bonaparte en Egypte*: Extracts (Holt & Co.); Balzac, *le Curé de Tours* (Heath & Co.); Thierry; *Récits des Temps mérovingiens* (Macmillan & Co.); Michelet, *Récits d'Histoire de France* (Hachette); Alfred de Vigny, *la Conque de jona*.

SUMMER COURSES OF INSTRUCTION.

Among the courses of instruction to be offered by Harvard University in the summer of 1897, will be several that can be counted, under the regulations of the Faculty of Arts and Sciences, towards the degree of S.B.

For the pamphlet describing the Summer School Courses apply to **M. CHAMBERLAIN**, University Hall, Cambridge, Mass.

GENERAL ACCOUNT OF THE SCHOOL.

The Lawrence Scientific School, together with Harvard College and the Graduate School, is under the control of the Faculty of Arts and Sciences of Harvard University. The instruction in these departments is given by the same teachers, mostly in classes which may be attended by pupils from any one of these schools. The life of the students in all three departments is in common; they share alike in all the advantages which the academic department of the University can afford them. So far as their plans may make it desirable, they are allowed without additional charge to attend lectures in the professional schools of the University.

The essential peculiarity of the Scientific School, as compared with the other schools which are managed by the Faculty of Arts and Sciences, is that the instruction which it provides for its students is arranged in groups of definite required courses, each of which is intended to afford in a four years' course of study the training necessary for one of the scientific professions, such as Engineering, Chemistry, Geology, etc. While with the consent of the Administrative Board of the School slight changes may be made in the prescribed studies in order to meet the particular needs of the individual student, the plan of these courses leading to the degree of Bachelor of Science must in general be adhered to. Students are, however, permitted, without additional charge, to attend any other instruction in addition to their required work which they may be fitted to pursue, except the exercises in special laboratories.

The School is a constituent part of Harvard University, and as such has the general advantages afforded by that institution. It is situated in Cambridge, a city of about eighty thousand inhabitants, at a distance of three miles from Boston, Mass. The city of Cambridge occupies a wholesome territory, and its sanitary state is good; it has been remarkably exempt from contagious diseases; during the several epidemics of cholera which have effected this country, the malady has appeared in but one household. In the United States census of 1880, Cambridge held the first place as regards healthfulness in the list of forty-three cities. The College buildings, including the dormitories, are subject to a careful sanitary inspection.

Students attending the School may lodge in the dormitories or in private houses, a list of which will be sent on application to the Secretary. They may take their meals in Memorial Hall, which affords accommodation for about 1100 persons; in the Foxcroft Club, which provides for about 300, or in private boarding houses.

Each student in the Scientific School has one of its officers designated as his Adviser, to whom he is to look for counsel concerning the conduct of his studies and for such other assistance as he may need during his residence at the University.

DEGREES.

THE DEGREE OF BACHELOR OF SCIENCE. — The degree of BACHELOR OF SCIENCE will be conferred upon any student who has fulfilled the requirements in any of the courses of study as laid down in the schedule. The grades of the degree with distinction of Bachelor of Science are *cum laude*, *magna cum laude*, and *summa cum laude*.

The grade of the degree and the course of study for which the degree is given will be specified in the Diploma.

DEGREES OF BACHELOR OF ARTS AND BACHELOR OF SCIENCE. — Students who wish to take the degree of S.B. in addition to the degree of A.B. may register in the Lawrence Scientific School after their third year in Harvard College (or after the satisfactory completion of fourteen courses counting toward the degree of A.B.). They may obtain the degree of A.B. on the satisfactory completion of the required number of courses counting toward that degree, and the degree of S.B. after at least two years in the Scientific School, the last year to be devoted to work prescribed by the Administrative Board of the Scientific School.

It is desirable that students who contemplate taking their degrees in this way seek advice in the selection of their studies while registered in the College, in order that they may enter the Scientific School fully prepared for the required work.

THE DEGREE OF DOCTOR OF SCIENCE. — The requisitions for the degree of DOCTOR OF SCIENCE are stated on p. 354 of the *University Catalogue*.

By recent action of the Governing Boards, the requirement of two years of residence at this University of a candidate for the Degree of Doctor of Science has been rescinded. The minimum requirement of residence is now *one year*, this period being fixed for all degrees by the Statutes. It is not the purpose of the change thus made to lower the standards for this degree; but only to reduce the amount of compulsory residence at this University. The Faculty will, in future, in estimating the amount of a candidate's study for the degree, give such weight as seems to them fitting, to advanced work done in the graduate department of another university.

HONORS.

Students in the Scientific School may be candidates for Honors at graduation on the same terms as students in Harvard College. See *University Catalogue*, p. 252.

REDUCTION OF THE COURSE TO THREE YEARS.

If a student has anticipated studies amounting to a substantial portion of the work of the First-Year, and desires to fulfil the requirements for the degree in three years, he may apply to the Administrative Board for leave so to do, specifying in his application the manner in which he proposes to arrange his studies for that purpose. The Administrative Board will decide on such applications according to the circumstances in each case.

INSTRUCTION IN OTHER DEPARTMENTS OF THE UNIVERSITY.

All students of the Scientific School may, if found competent, pursue any of the courses of instruction given in the other departments of the University, except exercises carried on in the special laboratories, without additional charge, but this provision does not apply to Special Students unless they pay the full tuition fee of \$150.

SCHOLARSHIPS.

Sixteen University Scholarships, of the annual value of one hundred and fifty dollars each, and three of two hundred dollars each, have been established in the Scientific School.

There are also scholarships in the Scientific School, not exceeding eight at any one time, of the annual value of one hundred and fifty dollars each, for the benefit of graduates of reputable Normal Schools in the United States.

These scholarships are assigned at the beginning of each academic year to meritorious students standing in need of such assistance.

One third of the annual value of the Scholarships is paid on January 12, one third on April 12, and one third immediately after the issue of the June term-bill.

Applications for these scholarships must be filed with the Secretary of the School by the 1st of July.

FELLOWSHIPS.

Graduates of the Scientific School may be appointed to the Parker Fellowships, the John Thornton Kirkland Fellowship, the Morgan Fellowships, and the John Tyndall Scholarship.

Students in the Scientific School may also be appointed to the Kirkland Fellowship and Tyndall Scholarship, and, if graduates of Harvard College, to any of the above Fellowships or to the Harris Fellowship. For full information, see *University Catalogue*, pp. 152-174.

PRIZES.

Students in the Lawrence Scientific School may compete for the Bowdoin Prizes, for full information in regard to which see *University Catalogue*, p. 175.

FEES, EXPENSES, AND BONDS.

Students are classified as Undergraduates and Special Students. The tuition fee of every Undergraduate for the academic year is \$150.

The following table exhibits four scales of annual expenditure,—clothing, washing, and the expenses of the long vacation not being included:—

	Low.	Moderate.	Liberal.	Very liberal.
Tuition	\$150	\$150	\$150	\$150
Books and Stationery . . .	25	35	45	61
Room	22	50	100	195
Furniture (annual average)	10	15	25	50
Board	114	152	152	304
Fuel and light	11	15	30	45
Societies and subscription to sports (annual average) .			35	50
Servant				25
Sundries	40	55	85	150
Total	\$372	\$472	\$622	\$1030

A student who pays the full fee of \$150, is entitled to all the general privileges of the University and he has the right to take any courses for which he is qualified, given under the authority of the Faculty of Arts and Sciences.

Every student who takes a laboratory course, must pay, in addition to his tuition fee, the special fees pertaining to his laboratory course or courses. For each laboratory course in Physics, the fee is \$10, which covers all charges. For study in the Chemical and Mineralogical laboratories, there is a general fee, which varies from \$5 to \$30, according to the nature and amount of the work undertaken, and also an individual fee for the use of materials in special investigations and for breakage, and in payment of fines for violation of the laboratory regulations. For laboratory courses in Natural History and in Psychology, the fee is \$5, which covers all charges. For instruction and the use of the work shops in the Rindge Manual Training School, the fee is \$15.



Members of the School — both regular and special students — must give bonds in the sum of \$200, signed by two bondsmen, one of whom must be a citizen of the United States, for the payment of all dues to the University. Instead of filing a bond, any student who prefers may pay his fees in advance, and deposit with the Bursar such a sum of money as may be deemed sufficient to secure payment of all other dues to the University. Every student who lives in a College room or boards at Memorial Hall or the Foxcroft Club must file a bond for \$400, or pay rent for the year in advance, and make a deposit with the Bursar as security for the payment of his board at the rate of \$5 a week.

No officer or student of the University is accepted as a bondsman.

The University bills are issued December 22, March 22, and one week before Commencement; and are payable January 12, April 12, and October 10; but the third bill of every candidate for a degree must be paid at least one day before Commencement. Each bill contains one-third of the annual charges. When a student withdraws from the School, his whole bill becomes payable at once.

Beginning with the academic year 1897-98, the term-bills will be issued on February 1 and one week before Commencement, and must be paid on or before February 21 and (except the bills of candidates for degrees) October 10, respectively. The first bill, that issued February 1, will contain two thirds; and the second bill will contain one third, of the annual charges.

The first third of the academic year begins with the academic year, and ends December 31. The second third begins January 1 and ends March 31. The last third begins April 1 and ends at Commencement.

A student who enters the School after the beginning of the academic year is charged for instruction from the beginning of the third in which he enters. One who withdraws during the year is charged only to the end of the third in which he leaves, if before that time he gives written notice of his withdrawal to the Dean of the School; otherwise he is charged to the end of the third in which such written notice is given.

Deduction from the full tuition-fee of \$150 a year is made for properly notified absence, as follows: for absence for three consecutive months, \$30; for absence during the whole year, not including the mid-year and final examinations, or either of them, \$100. A student who claims a deduction, on the ground of absence, must present at the Bursar's office a certificate from the Secretary as to the fact and duration of his absence; and in order to obtain such a certificate, he must have given previous notice of his intended absence to the Secretary.

TUITION-FEES OF SPECIAL STUDENTS.

The tuition-fees of special students are : —

For any laboratory course, alone or with other courses, \$150 a year.

For certain laboratory courses additional fees are required for materials, reagents, use and breakage of apparatus.

For any elective full-course, \$45 ; for a half-course, \$25 — a year.

In all other cases the fees will be computed at the rate of \$15 for an hour a week of instruction during the academic year up to \$150. But in no case shall the tuition-fee be less than \$30 or more than \$150.

Any student who attends a course of instruction for only a part of the year must pay the full year's fees for that course ; except that a student who is liable for the fee of \$150 a year is entitled to the same remission as undergraduates.

ROOMS AND BOARD.

A list of rooms available for students of the School, with their prices for the academic year, can be obtained during the summer, by application to the Secretary. Rooms in Divinity Hall and Divinity House, not taken by Divinity Students, will be assigned, on the Tuesday before the beginning of the academic year, to students who have previously applied for them. College rooms can, in some cases, be obtained, at the beginning of the year.

Members of any Department of the University can board at cost by joining the Association which uses the great dining-hall of Memorial Hall. The cost of board to the members of this association is ordinarily about \$4 a week. The Hall opens on the last Wednesday in September.

The Foxcroft Club is a coöperative organization for reducing the expenses of students, having quarters adjoining the College yard. Simple articles of food are furnished to order at cost, making it possible to board at the Club for from \$2.50 to \$3.00 a week. By using the Club's dining-room, members are enabled to lodge cheaply at a distance from the University or in suburban towns.

A committee of the Faculty and students have charge of some hundred sets of chamber and study furniture which are rented at extremely low rates.

The Harvard Coöperative Society is another organization for reducing expenses. At the store of the Society, clothing, books, stationery, wood, coal, etc., can be purchased at reduced prices.

PRICES OF COLLEGE ROOMS.—1897-98.

In each case the price is for the whole room from the beginning of the Academic Year until the next Commencement, and includes the daily care of the room.

- \$25. College House, Nos. 13, 35.
- \$45. College House, Nos. 57 and 58.
- \$50. College House, Nos. 22, 44, 66.
- \$60. { College House, Nos. 3, 4, 6, 7, 8, 9, 10, 15, 16, 18, 19, 20, 25,
26, 27, 28, 30, 31, 32, 37, 38, 39, 40, 41, 42, 46, 48, 50, 52, 54,
60, 62, 64, 70; Grays, Nos. 33, 35.
- \$70. { Hollis and Stoughton, Nos. 1, 2, 3, 4, 18, 19, 20; Stoughton,
No. 17; College House, Nos. 11, 12, 33, 34, 47, 49, 51, 53, 59,
61, 63, 67, 68, 69.
- \$75. { College House, Nos. 1, 2, 21, 23, 24, 43, 45, 55, 65; Grays,
Nos. 3, 13, 15, 17, 19, 34, 37, 49, 51; Weld, Nos. 25, 26,
52, 53.
- \$90. { Hollis and Stoughton, Nos. 5, 6, 8, 9, 10, 12, 13, 14, 16, 22, 23,
24, 26, 27, 28.
- \$100. { Hollis and Stoughton Nos. 29, 32; Hollis, No. 17; Grays, Nos.
1, 7, 11, 14, 18, 21, 23, 25, 27, 29, 31, 36, 39, 41, 45; Weld,
Nos. 24, 27, 51, 54; Matthews, Nos. 27, 28, 57, 58; Wadsworth
House, Nos. 9 and 10, 11 and 12; College House, No.
29; Holyoke, Nos. 39, 45; Foxcroft House, No. 6; Walter
Hastings, No. 61.
- \$125. { Hollis and Stoughton, Nos. 11, 15, 25, 30, 31; Hollis, No. 21;
Grays, Nos. 2, 9, 16, 22, 26, 30, 40, 47, 50, 52; Matthews, Nos.
25, 26, 29, 30, 55, 56, 59, 60; Holyoke, No. 28; Thayer,
Nos. 17, 18, 19, 20, 23, 24, 41, 42, 47, 48, 65, 66; Walter
Hastings, Nos. 13, 22, 23, 32, 46, 59; Foxcroft House, Nos. 1,
2, 5; Perkins, Nos. 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16,
18, 19, 20, 21, 22; Conant, Nos. 18, 30, 42.
- \$150. { Grays, Nos. 4, 6, 8, 10, 12, 20, 28, 32, 38, 42, 44, 46, 48; Holyoke,
Nos. 2, 3, 6, 11, 17, 40, 44, 46; Matthews, No. 6; Thayer, Nos.
1, 2, 3, 4, 13, 14, 15, 16, 25, 26, 30, 35, 36, 43, 44, 45, 46, 49,
50, 53, 59, 60, 63, 64, 67, 68; Foxcroft House, Nos. 3, 7, 8;
Walter Hastings, Nos. 45, 60; Perkins, Nos. 1, 2, 25, 26, 28 to
44, 47 to 66, and 69 to 88 inclusive.

- \$175. { Thayer, Nos. 5, 6, 8, 9, 10, 11, 12, 21, 22, 31, 32, 37, 38, 39, 40,
 51, 52, 55, 56, 57, 58, 61, 62; Weld, Nos. 3, 5, 8, 13, 14, 19,
 20, 30, 32, 34, 35, 40, 41, 46, 47; Holyoke, Nos. 12, 29, 34;
 Perkins, Nos. 23, 24, 45, 46, 67, 68; Foxcroft House, No. 4.
- \$200. { Thayer, Nos. 27, 28, 33, 34; Matthews, Nos. 3, 4, 10, 16, 22, 33,
 34, 46, 52; Holyoke, Nos. 18, 22, 23, 37, 41, 42, 43, 47, 48;
 Wadsworth House, No. 13; Weld, No. 1; Conant, Nos. 3, 4,
 5, 7, 8, 9, 10, 11, 12.
- \$225. { Weld, Nos. 4, 6, 9, 12, 15, 18, 21, 22, 23, 31, 33, 39, 42, 45, 48,
 49, 50; Matthews, Nos. 5, 9, 15, 19, 20, 21, 39, 45, 49, 50, 51;
 Holyoke, Nos. 1, 26, 30, 31, 32, 35, 36, 50; Wadsworth House,
 Nos. 5 and 6; Walter Hastings, Nos. 20, 30, 42; Conant, Nos. 1,
 2, 15, 16, 19, 20, 21, 22, 23, 24, 27, 28, 29, 31, 32, 33, 34, 35, 36,
 39, 40, 41, 43, 44, 45, 46, 47, 48.
- \$250. { Holworthy, Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17,
 18, 19, 21, 22, 23, 24; Weld, Nos. 2, 10, 11, 16, 17, 28, 29,
 37, 38, 43, 44; Matthews, Nos. 1, 2, 8, 13, 14, 23, 24, 31, 32,
 35, 36, 37, 38, 43, 44; Holyoke, Nos. 4, 9, 10, 13, 14, 15, 20,
 21, 24, 25, 38, 49; Wadsworth House, Nos. 3 and 4, 7 and 8;
 Walter Hastings, Nos. 14, 16, 18, 24, 26, 28, 33, 36, 39, 47, 50,
 53, 56; Conant, Nos. 13, 14, 25, 26, 37, 38.
- \$275. Matthews, Nos. 53, 54; Holyoke, Nos. 8, 19.
- \$300. { Matthews, Nos. 11, 12, 17, 18, 41, 42, 47, 48; Holyoke, Nos. 5,
 16, 27; Walter Hastings, Nos. 12, 21, 35, 38, 41, 44.
- \$325. { Walter Hastings, Nos. 3, 6, 9, 11, 15, 17, 19, 25, 27, 29, 31, 34,
 37, 40, 43, 57, 58.
- \$350. Walter Hastings, Nos. 1, 2, 4, 5, 7, 8, 10, 48, 49, 51, 54, 55.

DIVINITY HALL AND HOUSE.

Divinity Hall, the dormitory of the Divinity School, contains 42 rooms, ranging in price from \$40 to \$80. Divinity House, in the rear of Divinity Hall, contains 5 rooms.

All these rooms are primarily reserved for students of the Divinity School, and will not be assigned to other students until the Thursday on which the academic year begins. On that day a list of the rooms not previously engaged will be posted at the Bursar's office and applications may be made to him. The Dean of the Divinity School, however, reserves the right of discriminating between applications as the interests of the school may in his judgment dictate.

CONFERENCES, CLUBS, READINGS, ETC.

Important work is done by Graduate Students in Conferences and Clubs which exist in more or less close connection with the several Departments of study, and meet frequently. These organizations, concerning which detailed information is given in the Departmental pamphlets or may be obtained from instructors, include the following:—

- SEMITIC CONFERENCE: twice a month.
- SANSKRIT CONFERENCE: fortnightly in the second half-year.
- CLASSICAL CLUB: fortnightly.
- MODERN LANGUAGE CONFERENCE: fortnightly.
- DEUTSCHER VEREIN: fortnightly.
- CERCLE FRANÇAIS: fortnightly.
- PHILOSOPHICAL CONFERENCE: monthly.
- HARVARD PEDAGOGICAL CLUB: fortnightly.
- HARVARD MEMORIAL SOCIETY.
- HARVARD FOLK-LORE SOCIETY.
- PHYSICAL COLLOQUIUM: weekly.
- HARVARD CHEMICAL CLUB: fortnightly.
- BOYLSTON CHEMICAL SOCIETY: fortnightly.
- BOTANICAL CONFERENCE: fortnightly.
- BOTANICAL CLUB: fortnightly.
- ZOOLOGICAL CLUB: fortnightly.
- GEOLOGICAL CONFERENCE: weekly.
- HARVARD NATURAL HISTORY SOCIETY: bi-monthly.

Many of the Seminary courses have also something of the character of conferences.

The GRADUATE CLUB is an organization composed of students in the Graduate School, elected on recommendation of the Executive Committee of the Club. Its aim is to promote social intercourse and a general acquaintance among its members with the work done in all the different Departments of the School. Talks by members of the Club on methods and results in the various Departments and addresses by other persons on matters of literary and scientific interest are given at its meetings. The Club holds a reception for all officers and students of the School near the beginning of each academic year. The circular of the Club may be obtained on application.

Graduate Students may also become members of many of the large number of societies which exist in the University for religious, ethical, political, literary, musical, and social objects.

They may also join the Harvard Dining Association, which uses the great dining-room of Memorial Hall, or the Foxcroft Club, a coöperative

organization for reducing the expenses of students, having quarters near the College yard.

Besides the regular courses of instruction, many public LECTURES and READINGS are given each year under the auspices of the University, on topics interesting to students in connection with their work.

A public series of Orchestral Concerts is given each year at Sanders Theatre in Memorial Hall by the Boston Symphony Orchestra.

The HEMENWAY GYMNASIUM is open to Graduate Students.

PUBLICATIONS.

A few Departments of study issue periodicals or yearly volumes, embodying the work of instructors and students at the University. Other Departments make regular contributions, under an official heading, to the proceedings of certain learned societies or to journals of literature and science, existing outside of the University. The publications which proceed directly from the Departments are the following:—

HARVARD ORIENTAL SERIES (Indo-Iranian Department): Vols. I-III issued. Vols. IV and V in press.

HARVARD STUDIES IN CLASSICAL PHILOLOGY (yearly): Vols. I-VII issued. Vol. VIII in press.

STUDIES AND NOTES IN PHILOLOGY AND LITERATURE (Modern Language Departments): yearly. Vols. I-IV issued. Vol. V in press.

HARVARD HISTORICAL STUDIES: published under the direction of the Department of History and Government, from the income of the Henry Warren Torrey Fund. Vols. I-III issued.

QUARTERLY JOURNAL OF ECONOMICS: in its twelfth year.

ANNALS OF THE OBSERVATORY OF HARVARD COLLEGE: thirty-three volumes issued.

PUBLICATIONS OF THE MUSEUM OF COMPARATIVE ZOOLOGY:—BULLETIN, twenty-nine volumes issued; MEMOIRS BY PROFESSORS AND ASSISTANTS, twenty-two volumes issued.

CONTRIBUTIONS FROM THE ZOOLOGICAL LABORATORY: seventy-one numbers issued. (Some of the contributions are also contained in the Museum Bulletin.)

PUBLICATIONS OF THE PEARBODY MUSEUM OF AMERICAN ARCHAEOLOGY AND ETHNOLOGY:—ANNUAL REPORTS, twenty-five numbers issued; PAPERS, five numbers issued; MEMOIRS, one number issued.

The **HARVARD GRADUATES' MAGAZINE**, issued quarterly, and now in its fifth year, gives a record of the current life and work of the University, biographical and bibliographical data regarding Graduates, besides articles on other matters of general interest.

THE UNIVERSITY CHAPEL.

FRANCIS GREENWOOD PEABODY, D.D., *Plummer Professor of Christian Morals.*

JOHN HEYL VINCENT, D.D.

SAMUEL D McCONNELL, D.D.

GEORGE HODGES, D.D.

PHILIP S. MOXOM, D.D.

WILLIAM WALLACE FENN, D.B.

} *Preachers to the University
for the year 1896-97.*

There have also served on this Board of Preachers since its foundation in 1886:—

EDWARD EVERETT HALE, D.D.

ALEXANDER McKENZIE, D.D.

THEODORE C. WILLIAMS, D.B.

GEORGE A. GORDON, D.D.

PHILLIPS BROOKS, D.D.

WILLIAM LAWRENCE, S.T.D.

BROOKE HERFORD, D.D.

HENRY VAN DYKE, D.D.

LYMAN ABBOTT, D.D.

CHARLES CARROLL EVERETT, D.D.

WASHINGTON GLADDEN, D.D.

LEIGHTON PARKS, D.D.

J. ESTLIN CARPENTER, A.M.

E. WINCHESTER DONALD, D.D.

SAMUEL McCHORD CROTHERS, A.B.

SIMON J. McPHERSON, D.D.

On May 10, 1886, a vote was passed by the President and Fellows "That five preachers to the University be annually appointed by the President and Fellows, with the concurrence of the Board of Overseers, who, in conjunction with the Plummer Professor of Christian Morals, shall arrange and conduct the religious services of the University." The Board of Overseers concurred in this vote on May 12, 1886, and in 1892 it was incorporated in the Statutes of the University.

On June 14, 1886, on the unanimous recommendation of the Preachers and the Plummer Professor, the President and Fellows voted "That the statute numbered 15, concerning religious exercises, be amended by striking out the clause, "at which the attendance of the students is required";

and on June 16 the Board of Overseers concurred in this vote. Attendance at the religious services of the University was thus, by the advice of those who conduct these services, made wholly voluntary.

These services in the University Chapel are directed by the Plummer Professor and the Preachers to the University as follows: Each conducts daily morning prayers for about three weeks in the first half-year and about three weeks in the second half-year, and each preaches on four Sunday evenings. The Preacher conducting morning prayers is in attendance every morning during his term of duty at Wadsworth House 1, and is at the immediate service of any student who may desire to consult him. This arrangement puts at the disposal of the students a greater amount of pastoral service than most ministers can give to their own parishes. On Thursday afternoons from November till May, vesper services are held in the University Chapel. These services are brief (35-40 minutes), largely musical (with full male choir—25 sopranos and altos, 16 tenors and basses), and with an address from one of the staff of Preachers. Other services on Sunday evenings are conducted by preachers of various communions by invitation of the Board of Preachers. The following preachers thus conducted services during the year 1895-96:—

Rev. President FRANCIS J. PATTON, D.D., of Princeton University.

Rev. BROOKE HERFORD, D.D., of London, England.

Rev. ENDICOTT PRABODY, of Groton.

Rev. President W. DEWITT HYDE, D.D., of Bowdoin College.

Rev. President WILLIAM J. TUCKER, D.D., of Dartmouth College.

Rev. MINOT J. SAVAGE, D.D., of Boston.

Mr. WILLIAM M. SALTER, of Chicago, Ill.

Rev. T. EDWIN BROWN, D.D., of Providence, R. I.

Rev. GEORGE W. DOUGLAS, D.D., of New Haven, Conn.

Rev. W. W. FENN, of Chicago, Ill.

The Board of Preachers are glad to have their attention called to any cases of special need where they may be useful, or to any better methods of serving the moral and religious interests of the University. General correspondence for the current academic year should be addressed to the Plummer Professor, though any Preacher will gladly consider such questions as may be more appropriately addressed to him.

In addition to the opportunities for worship in Appleton Chapel, seats are provided for students, at the expense of the College, in the churches of the different denominations in Cambridge. St. John's Memorial Chapel of the Episcopal Theological School having been erected for the especial accommodation of Harvard students is free to them.

THE UNIVERSITY LIBRARY.

COUNCIL.

CHARLES W. ELIOT, LL.D., *President.*
CHARLES ELIOT NORTON, LL.D., *Professor of the History of Art.*
CHARLES F. DUNBAR, LL.D., *Professor of Political Economy.*
JUSTIN WINSOR, LL.D., *Librarian of the University.*
CRAWFORD H. TOY, LL.D., *Professor of Hebrew.*
GEORGE L. GOODALE, LL.D., *Professor of Botany.*
MORRIS H. MORGAN, LL.D., *Assistant Professor of Latin.*

COLLEGE LIBRARY.

JUSTIN WINSOR, LL.D., *Librarian, and Keeper of the University Records.*
WILLIAM H. TILLINGHAST, A.B., *Assistant Librarian.*
THOMAS J. KIERNAN, A.M., *Superintendent of Circulation.*
ALFRED C. POTTER, A.B., *Ordering Department.*
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WALTER B. BRIGGS, *Superintendent of Reading Room.*

JOHN H. STORER, LL.B., *Curator of Coins.*
JAMES ATKINS NOYES, A.B., *Editor of the Quinquennial Catalogue.*
WILLIAM G. BROWN, A.M., *Deputy Keeper of the University Records.*

DEPARTMENTAL LIBRARIES.

The care of the several departmental, laboratory, and class-room libraries devolves upon some member of the faculties of the respective Departments, when regular librarians have not been appointed.

CHARLES S. SARGENT, A.B., *Professor, and Director of the Arnold Arboretum.*
WILLIAM L. RICHARDSON, A.M., M.D., *Professor, and Dean of the Medical School.*
IRA N. HOLLIS, *Professor of Engineering.*

FRANCIS H. STORER, S.B., A.M., *Professor, and Dean of the Bussey Institution.*

EDWARD C. PICKERING, LL.D., *Professor, and Director of the Astronomical Observatory.*

B. L. ROBINSON, Ph.D., *Curator of the Herbarium, Botanic Garden.*

FREDERIC W. PUTNAM, S.D., *Professor, and Curator of the Peabody Museum.*

ROBERT S. MORISON, A.M., D.B., *Librarian of the Divinity School.*

JOHN H. ARNOLD, *Librarian of the Law School.*

FRANCES M. SLACK, *Librarian of the Zoölogical Museum.*

CHARLES H. MOORE, A.M., *Professor and Director of the Fogg Art Museum.*

LABORATORY LIBRARIES.

JOHN TROWBRIDGE, S.D., *Professor, in charge of the Physical Library.*

THEODORE W. RICHARDS, Ph.D., *Assistant Professor, in charge of the Chemical Library.*

GEORGE L. GOODALE, M.D., LL.D., *Professor, in charge of the Botanical Library.*

EDWARD L. MARK, Ph.D., LL.D., *Professor, in charge of the Zoölogical Library.*

NATHANIEL S. SHALER, S.D., *Professor, in charge of the Geological Library.*

WILLIAM M. DAVIS, M.E., *Professor, in charge of the Physical Geography Library.*

J. E. WOLFF, Ph.D., *Professor, in charge of the Mineralogical Library.*

WILLIAM JAMES, M.D., Ph. et Litt.D., *Professor, in charge of the Psychological Library.*

CLASS-ROOM LIBRARIES.

CHARLES R. LANMAN, Ph.D., *Professor, in charge of the Sanskrit Library.*

ALBERT A. HOWARD, Ph.D., *Assistant Professor, in charge of the Classical Library.*

GEORGE L. KITTEDGE, A.B., *Professor, in charge of the English Library.*

H. K. SCHILLING, Ph.D., *Assistant Professor, in charge of the German Library.*

F. C. DE SUMICHRIST, Assistant Professor, in charge of the French Library.

FRANCIS G. PEABODY, D.D., *Professor, in charge of the Social Questions Library.*

EDWARD S. SHELDON, A.B., *Professor, in charge of the Romance Languages Library.*

EDWARD CUMMINGS, A.M., *Assistant Professor, in charge of the Political Economy Library.*

ALBERT B. HART, PH.D., *Assistant Professor, in charge of the United States History Library.*

JOHN K. PAINE, A.M., MUS.D., *Professor, in charge of the Library of Music.*

WILLIAM E. BYERLY, PH.D., *Professor, in charge of the Mathematical Library.*

SILAS M. MACVANE, PH.D., *Professor, in charge of the History Library.*

CRAWFORD H. TOY, LL.D., *Professor, in charge of the Semitic Library.*

CHARLES ELIOT NORTON, LITT.D., LL.D., *Professor, in charge of the Fine Arts Library.*

H. LANGFORD WARREN, *Assistant Professor, in charge of the Architectural Library.*

The College Library in Gore Hall is for the use of the whole University. All students who have given bonds may take out books, three volumes at a time, and may keep them one month. Books, reserved at the instance of officers of instruction, as collateral reading for their courses, are shelved in the Reading Rooms, with tables for consultation. Students who leave Cambridge for an absence of more than one week must first return all borrowed books.

The College Library is open every week-day, except Thanksgiving day, Christmas day, the Twenty-second of February, Patriots' day, Memorial day, and the Fourth of July, after 9 A.M. In vacation no books are to be taken out after 2 P.M.; but the library can be used for consultation, except on Saturdays, after 2 o'clock P.M. On Sundays during term time the Library is open, for readers only, after 1 o'clock P.M.

The College Library may be consulted by all persons, whether connected with the University or not. The privilege of borrowing books is also granted, under special regulations, to persons not connected with the University. *Blanks for making applications for such use may be had of the Librarian.*

Persons entitled to use the College Library can have access to the departmental libraries by applying to the Superintendent of Circulation at Gore Hall; but such libraries are primarily for the special use of the schools and departments, and are placed in the buildings or rooms belonging to such schools and departments.

The several libraries now contain about the following numbers of bound volumes : —

Gore Hall	346,000
Lawrence Scientific School (Engineering Library)	5,000
Bussey Institution (Jamaica Plain)	3,600
Phillips Library (Observatory)	8,300
Botanic Garden (Herbarium Library)	7,200
Law School	38,000
Divinity School	27,100
Medical School (Boston)	2,200
Museum of Comparative Zoölogy	31,000
Peabody Museum	1,800
Arnold Arboretum	5,500
Fogg Museum	100*
Seven laboratory and sixteen class-room libraries	14,500
	<hr/> 490,300

The collection of pamphlets and maps in the College Library is very large, and is estimated to be equal in number to the collection of bound volumes. The departmental libraries have also considerable numbers of pamphlet monographs on subjects connected with their specialties; and these are not included in the count of volumes. The College Library has also a collection of coins.

The catalogue of the Gore Hall Collection, including pamphlets, is on cards, accessible to the public, and consists of two parts, the one arranged by authors, the other by subjects. Printed strips of titles added to all the libraries are issued two or three times a week; and they are posted in Gore Hall and in the departmental libraries. They are also included in bound volumes of slips, kept in the Reading Room. A series of "Bibliographical Contributions," is in course of publication. Fifty-one of such publications have already been issued. More extensive bibliographical works constitute another series, "Special Publications," of which Scudder's "Catalogue of Scientific Serials" (1633-1876, 8vo, pp. 370) makes No. 1, published in 1879, and "An Index to the Subject Catalogue of Harvard College Library" makes No. 2, published in 1891. There has also been issued a Catalogue of the Gray Collection of Engravings (4to, 1869); but this collection has, for the present, been transferred from the Library to the Museum of Fine Arts in Boston.

The Librarian has the custody of the Archives of the University, as well as of the University Collection, which includes printed material of all sorts, illustrating the history of the College and University.

* In addition a large collection of photographs of Paintings, Sculpture, and Architecture, and many casts.

THE CHEMICAL LABORATORY.

OFFICERS.

HENRY B. HILL, A.M., *Director, and Professor of Chemistry.*
CHARLES L. JACKSON, A.M., *Erving Professor of Chemistry.*
THEODORE W. RICHARDS, PH.D., *Assistant Professor of Chemistry.*
JOSEPH TORREY, JR., PH.D., *Instructor in Chemistry.*
OLIS F. BLACK, A.M., *Assistant in General Chemistry.*
GEORGE W. COGGESHALL, PH.D., *Assistant in Physical Chemistry.*
FRANK B. GALLIVAN, A.M., *Assistant in Descriptive Chemistry.*
WILLIAM F. BOOS, PH.D., *Assistant in Descriptive Chemistry.*
CHARLES A. SOCH, A.B., *Assistant in Organic Chemistry.*
JOHN P. SYLVESTER, A.M., *Assistant in Qualitative Analysis.*
GREGORY P. BAXTER, A.B., *Assistant in Quantitative Analysis.*
FRANK H. GAZZALO, PH.B., *Assistant in Descriptive Chemistry.*
WILLIS B. HOLMES, A.B., *Assistant in Qualitative Analysis.*
BENJAMIN S. MERIGOLD, A.B., *Assistant in Descriptive Chemistry.*
JOHN W. DOW, *Assistant in Qualitative Analysis.*
ROBERT W. FULLER, *Assistant in Descriptive Chemistry.*
ROBERT R. HOLLISTER, *Assistant in Descriptive Chemistry.*

The Chemical Department occupies the whole of Boylston Hall.

Boylston Hall was erected in 1857 with a fund bequeathed by the late WARD NICHOLAS BOYLSTON, which was subsequently largely increased by subscription. The hall was enlarged by the addition of a third story in 1870, and the accommodations were still further extended in 1891 and 1895. Besides several private laboratories and preparation rooms, the building contains seven large laboratories for students. A room on the upper story with ninety-eight desks is especially devoted to qualitative and descriptive work. A large laboratory at the west end is fitted with all the modern appliances for the study of organic chemistry. On the lower story a laboratory with forty-four places is reserved wholly for quantitative work, and connected with it is a laboratory, with twelve desks, especially fitted up for advanced work in inorganic chemistry. On the same story is a room devoted to work in physical chemistry; and

further a large laboratory with one hundred and twenty-eight places for the most elementary class. In the basement is a laboratory for work in descriptive chemistry with two hundred and thirty-two desks. On the second story are two large lecture-rooms, a reading-room, departmental library, and a chemical museum.

All the courses of instruction in Chemistry to students of Harvard College, of the Lawrence Scientific School, and of the Graduate School, are given in Boylston Hall. The laboratories are open to special students to follow any line of chemical investigation. The facilities for research are unusually great.

JEFFERSON PHYSICAL LABORATORY.

JOHN TROWBRIDGE, S.D., *Director.*
EDWIN H. HALL, Ph.D., *Professor.*
BENJAMIN O. PEIRCE, Ph.D., *Professor.*
WALLACE C. SABINE, A.M., *Assistant Professor.*
LEWIS D. HILL, A.B., *Assistant.*
ASA W. K. BILLINGS, A.M., *Assistant.*
WILLIAM D. COLLINS, A.B., *Assistant.*
AUTHUR DURWARD, S.B., *Assistant.*
WILLIAM E. McELFRESH, A.M., *Assistant.*
GEORGE W. THOMPSON, *Mechanician.*

In 1881 Mr. T. JEFFERSON COOLIDGE gave \$115,000 to the College for a new physical laboratory, on condition that \$75,000 should be raised by subscription and the income appropriated to its support. The building was finished in Oct., 1884, and is called the Jefferson Physical Laboratory. All the instruction in Physics, by recitations, lectures, and experimental work, to students of Harvard College, of the Lawrence Scientific School, and of the Graduate School, is given in this building, which accommodates the various physical cabinets. The building is four stories high, if the basement is included. In the eastern wing the whole height is divided between a large lecture-room below, and the great laboratory above. In the central and western portions of the building are three recitation-rooms for sections of forty or less; but the principal part of the central and western portions is broken up into a large number of small rooms, where the professors, assistants, and advanced students can pursue their separate investigations, and be secured against intrusion, or any disturbance of their instruments. In the basement and first story, stone tables, each supported by its own column of masonry, and without contact with the floors, furnish firm support for these instruments. In the centre of the western wing a large rectangular tower stands on an independent foundation, and is isolated from the surrounding rooms. It is designed for investigations which demand extraordinary stability, or a great height: as in Foucault's pendulum-experiment. Small openings have been left in the brick partitions which divide the length of the building, by means of which a long path is available for such experi-

ments as that on the velocity of light. In the western wing, iron nails and pipes which would disturb delicate experiments in magnetism, were excluded in the construction of the building. In the bottom of the tower is a small underground room which may be used for experiments requiring a constant temperature.

A room is devoted to the accurate measurement of electrical resistances and is provided with standard coils.

A comparator for the measurement and comparison of standards of length occupies a room in the basement of the laboratory.

The photographic room adjoins a large space on the fourth floor, which contains the rooms especially arranged for spectrum analysis. There are four principal laboratory rooms. One of these is 40x60 feet and is devoted to elementary laboratory instruction. A time wire from the Observatory is led to this room. The laboratory for advanced instruction in electricity is in the basement and is provided with instruments of the latest type. A machine room is supplied with power from an electric motor. In this room is a milling machine, a large machine lathe, a smaller lathe, and other mechanical appliances for designing and making apparatus. The machine room is under the charge of a skilled mechanician. Power can also be obtained from a twenty-five-horse-power engine which is placed in a house outside of the laboratory.

THE UNIVERSITY MUSEUM

AND

NATURAL HISTORY LABORATORIES.

The University Museum consists of the Museum of Comparative Zoölogy, the Botanical Museum, the Mineralogical Cabinet, the Natural History Laboratories, and the Peabody Museum of American Archaeology and Ethnology.

The entrance to the Museum of Comparative Zoölogy and the Peabody Museum is from Divinity Avenue. The Natural History Laboratories, the Botanical and Mineralogical Departments are entered from Oxford Street.

The Museum of Comparative Zoölogy consists of the North wing of the University quadrangle (60 x 200 feet). The Natural History Laboratories are in the N. W. corner piece of the same quadrangle (95 x 75), and in the adjoining sections of the central part of the University Museum of the Oxford Street façade.

The Botanical Museum occupies the central section of the University Museum, together with one-third of the southern sections.

The Mineralogical Museum occupies the southern section of the Oxford Street façade (60 x 60).

The S. W. corner piece will contain large Lecture Rooms and Laboratories for the Natural History Departments, and its Exhibition Rooms will connect the Oxford Street façade of the Museum with the Peabody Museum (see p. 529), which, when completed, will form the South wing of the Museum building.

THE MUSEUM OF COMPARATIVE ZOÖLOGY.

FACULTY.

CHARLES W. ELIOT, LL.D., *President.*

ALEXANDER AGASSIZ, LL.D., *Curator.*

———, *Secretary.*

GEORGE L. GOODALE, M.D., LL.D.

HENRY P. WALCOTT, A.B., M.D.

OFFICERS.

ALEXANDER AGASSIZ, LL.D., *Director and Curator.*

———, *Sturgis Hooper Professor of Geology.*

NATHANIEL S. SHALER, S.D., *Professor of Geology.*

EDWARD L. MARK, LL.D., *Hersey Professor of Anatomy.*

WILLIAM M. DAVIS, M.E., *Professor of Physical Geography.*

HENRY L. SMYTH, A.B., C.E., *Assistant Professor of Mining.*

Appointed by the Faculty of the Museum.

WALTER FAXON, S.D., *Assistant in charge.*

SAMUEL GARMAN, *Assistant in Herpetology and Ichthyology.*

WILLIAM BREWSTER, *Assistant in Ornithology and Mammalogy.*

ALPHEUS HYATT, S.B., *Assistant in Invertebrate Palaeontology.*

SAMUEL HENSHAW, *Assistant in Entomology.*

WILLIAM McM. WOODWORTH, PH.D., *Assistant in charge of Vermes.*

ALFRED G. MAYER, *Assistant in charge of Echinoderms, Polyps, etc.*

CHARLES R. EASTMAN, PH.D., *Assistant in Vertebrate Palaeontology.*

FRANCES M. SLACK, *Librarian.*

MAGNUS WESTERGREN, *Artist.*

Appointed by the Corporation.

JAY B. WOODWORTH, S.B., *Instructor in Geology.*

W. McM. WOODWORTH, PH.D., *Instructor in Microscopical Anatomy.*

ROBERT T. JACKSON, S.D., *Instructor in Palaeontology.*

GEORGE H. PARKER, S.D., *Instructor in Zoölogy.*

CHARLES B. DAVENPORT, PH.D., *Instructor in Zoölogy.*

HENRY R. LINVILLE, A.M., *Assistant in Zoölogy.*

JOHN I. HAMAKER, A.M., *Assistant in Zoölogy.*

JOSEPH H. HATHAWAY, A.B., *Assistant in Zoölogy.*

ROBERT DE C. WARD, A.M., *Instructor in Meteorology.*

THOMAS A. JAGGAR, JR., A.M., *Instructor in Geology.*

VERNON F. MARSTERS, A.B., *Assistant in Physical Geography.*

ROBERT J. FORSYTH, A.M., *Instructor in Metallurgy.*

GEORGE C. CURTIS, *Assistant in the Geographical Laboratory.*

JOSEPH E. WOODMAN, S.B., *Assistant in the Geological Laboratory.*

The Museum was founded by private subscription in 1859 with the assistance of the State of Massachusetts. In 1876 the property in the hands of the Trustees was transferred to the President and Fellows of Harvard College.

The Museum is under the management of a Faculty, who nominate the Curator, the Sturgis Hooper Professor, and appoint the Assistants.

The Curator is charged with the direction of the scientific and educational interests of the Museum, as well as of its relations to the public.

The Exhibition Rooms open to the public are the Synoptic Room, the rooms containing the systematic collections of Mammals, Birds, Reptiles, Fishes, Mollusks, Crustacea and Insects, Radiates, Sponges and Protozoa, also the rooms devoted to the faunal collections of Europe, of North and South America, the Indo-Asiatic, the African, the Australian Realms, and the Atlantic and Pacific Rooms and the Rooms devoted to the Quaternary, Tertiary and Mesozoic fossils. The collections, so far as arranged, are open to visitors every week-day, from 9 A.M. till 5 P.M., and on Sunday, from 1 P.M. till 5 P.M. Entrance on the south side of the North wing.

The publications of the Museum consist of an annual Report (1861-1896) of an octavo Bulletin (vols. i.-xxix.) and of Memoirs in quarto (vols. i.-xviii.). The Bulletin and Memoirs are devoted to the publication of original work by the Professors and Assistants of the Museum, of investigations carried on by students and others in the different laboratories of Natural History, and of work by specialists based upon the Museum collections.

The Library of the Museum is on the second floor of the N. W. corner of the Museum. It is intended for the use of the Professors and students of the Natural History departments. The Library contains over 23,000 volumes, exclusive of 2600 volumes of pamphlets, and of the Whitney Library containing about 5000 volumes and nearly 1500 pamphlets. The reading room is open from 9 to 1 and from 2 to 5.

LABORATORIES.

OF ZOÖLOGY, PALAEONTOLOGY, ENTOMOLOGY, GEOLOGY, PETROGRAPHY, AND PHYSICAL GEOGRAPHY.

The courses of instruction in Geology, Physical Geography and Meteorology, Palaeontology, Zoölogy, Microscopical Anatomy, Embryology, Entomology, are given in the laboratories (entrance on Oxford Street) connected with the Museum.

Courses of instruction in Geology numbered 2, 6, 7, 20, and 21, by Professor Davis, and Course 1 by Mr. Ward, are given in the Geological lecture-room and in the Geographical laboratories. Courses 4, 13, 14, 15, 18, 22a, 24, 25, and 26, by Professor Shaler, Dr. Jackson, and Mr. Jaggard, are given in the Geological and Palaeontological laboratories and lecture-room. Courses 8 and 16 are given by Mr. J. B. Woodworth in the Geological lecture-room. Courses in Zoölogy numbered 1, 2, 3,

4, 5, 6, 7, 20a, by Professor Mark and Drs. Davenport, Parker, and W. McM. Woodworth, are given in the Zoölogical and Embryological laboratories.

The Instructors and Assistants of the Museum also receive Special Students in their respective departments.

The income of the Humboldt Fund (about \$400) is applied, with the advice of the Faculty of the Museum, towards the maintenance of one or more persons engaged in study at the Museum, at the Newport Marine Laboratory, or at the Wood's Holl Fish Commission Station.

Several tables of the Newport Marine Zoölogical Laboratory are reserved for advanced students. Two of the tables of the U. S. Fish Commission at Wood's Holl are also at the disposal of the Director of the Museum, to whom application should be made before the first of May. Candidates should specify their qualifications and the work they intend to carry out.

The Virginia Barret Gibbs Scholarship, of the value of \$250, is assigned annually with the approval of the Faculty of the Museum at the recommendation of the Professors of Zoölogy and of Comparative Anatomy in Harvard University "in supporting or assisting to support one or more students who may have shown decided talents in Zoölogy and preferably in the direction of Marine Zoölogy."

THE BOTANICAL MUSEUM.

GEORGE L. GOODALE, M.D., LL.D., *Fisher Professor of Natural History.*

WILLIAM G. FARLOW, M.D., LL.D., *Professor of Cryptogamic Botany.*

ROLAND THAXTER, PH.D., *Assistant Professor of Cryptogamic Botany.*

ARTHUR B. SEYMOUR, S.M., *Assistant in Cryptogamic Herbarium.*

ALBERT R. SWEETSER, A.M., *Assistant in Botany.*

FREDERICK O. GROVER, A.B., *Assistant in Botany.*

HERBERT L. JONES, A.M., *Instructor in Botany.*

JOSEPH W. BLANKINSHIP, A.B., *Assistant.*

JOHN G. HALL, A.B., *Assistant in Botany.*

RUDOLPH BLASCHKA, *Artist-naturalist.*

The collections accessible to the public are on the third floor of the central section of the University Museum. They are designed to illustrate the principal systematic, biological and economic relations of plants. The large and increasing Ware Collection of glass models of flowers and other plants, prepared by the artists Leopold and Rudolph Blaschka of Germany, occupies the large exhibition room. Contiguous rooms contain collections of Cryptogams and economic products.

LABORATORIES

OF CRYPTOGRAMIC AND PHANEROGAMIC BOTANY.

The Cryptogamic Laboratories occupy the whole of the fifth floor (60 x 120). Here is also kept the extensive Herbarium of Algae, Fungi, and Lichens. (Not open to the public.)

The Laboratories of Phanerogamic Botany are on the second floor, and are supplemented by private workrooms in other parts of the botanical section. On the ground floor is stored for the present the large collection of Fossil plants.

The N. C. Nash Botanical Lecture-room, the gift of a recent graduate in memory of his father, is on the first floor of the Museum.

MINERALOGICAL MUSEUM.

JOHN E. WOLFF, PH.D., *Curator, and Professor of Petrography and Mineralogy.*

CHARLES L. JACKSON, A.M., *Erving Professor of Chemistry.*

WILLIAM M. DAVIS, M.E., *Professor of Physical Geography.*

CHARLES PALACHE, PH.D., *Instructor in Mineralogy.*

F. LESLIE RANSOME, PH.D., *Assistant in Mineralogy and Petrography.*

The mineralogical section of the University Museum, built in 1890-91 with a fund of about \$50,000, raised wholly by subscription, forms the southern end of the whole Museum, so far as at present completed. Entrance is by the south door on Oxford Street.

The exhibition room and gallery occupy the third and fourth floors and are open to the public on Wednesday and Sunday afternoons, from 1 to 5, and Saturday from 9 to 5.

The main mineralogical collections of the University are deposited here; they contain on the ground floor and gallery the large systematic collection with special features and collections, such as the J. Lawrence Smith collection of meteorites, the William Sturgis Bigelow agates, the Hamlin collection of tourmalines, and many unique specimens presented by James A. Garland and others.

MINERALOGICAL LABORATORIES.

The Laboratories of Mineralogy and Petrography occupy the second floor, first floor, and basement, and contain a laboratory for advanced crystallographic investigation and optical mineralogy on the second floor; the large lecture room, general laboratory for elementary mineralogy and blow-pipe analysis, preparation-room and library on the first floor, and in the basement a chemical laboratory equipped for mineral and rock analysis, and two assay rooms equipped with furnaces for assaying and metallurgy.

The courses in mineralogy, crystallography, and petrography (Mineralogy 2, 7¹, 8², 12, 20a, 20b) are given in these laboratories, where the instructors also receive properly qualified students who wish to follow special lines of mineralogical investigation.

THE PEABODY MUSEUM
OF
AMERICAN ARCHAEOLOGY AND ETHNOLOGY.

OCTOBER 8, 1866.

TRUSTEES.

STEPHEN SALISBURY, A.M., LL.B., *Chairman.*
FRANCIS CABOT LOWELL, A.B., *Treasurer.*
SAMUEL HUBBARD SCUDDER, S.D., LL.D.
WILLIAM H. NILES, PH.B., A.M.
ALEXANDER AGASSIZ, LL.D.
CHARLES FRANCIS ADAMS, LL.D.
ROBERT S. RANTOUL, A.M., LL.B.

OFFICERS AND ASSISTANTS.

FREDERIC WARD PUTNAM, A.M., S.D., *Curator, and Peabody Professor of American Archaeology and Ethnology; Secretary of the Board of Trustees.*
FRANK RUSSELL, A.B., S.M., *Assistant in Anthropology (Holder of the Hemenway Fellowship).*
CHARLES C. WILLOUGHBY, *Assistant in Museum.*
JANE SMITH, *Assistant.*
FRANCES H. MEAD, *Assistant.*
ALICE C. FLETCHER, *Assistant (Holder of the Thaw Fellowship).*
ZELIA NUTTALL, *Assistant in Mexican Archaeology.*
EDWARD E. CHICK, *Assistant in Charge of the Building.*

COMMITTEE OF THE DEPARTMENT.

Professors Frederic W. Putnam, George L. Goodale, and David G. Lyon,
and Messrs. Charles P. Bowditch and Francis C. Lowell.

VISITING COMMITTEE APPOINTED BY THE BOARD OF OVERSEERS.

Augustus Hemenway, Charles P. Bowditch, Henry W. Haynes, Jesse W. Fewkes, Clarence J. Blake, George A. Nickerson, Francis L. Higginson.

The entrance to the Museum is on Divinity Avenue. The present building is one-half of the contemplated structure which will form the southern wing of the University Museum. The Museum is in charge of the Curator and is open to the public, under proper restrictions, from 9 A.M. till 5 P.M. throughout the year, Sundays and holidays excepted. The arrangement of the collections is intended to facilitate research in General Anthropology with special reference to American and Comparative Archaeology and Ethnology. One of the galleries is temporarily occupied by the Semitic Museum of the University. The Mary Hemenway Collection of Archaeology and Ethnology of the southwestern tribes is arranged in the second gallery and in the large hall on the floor above. The collection obtained from the ancient ruins of Copan, by the special expeditions of the Museum, is arranged in the large hall on the third floor. The crowded condition of the hall will not permit its being opened to the public, but visitors will be admitted by applying at the office. The Anthropological Library, containing 1,755 volumes and 2,321 pamphlets, is open to members of the University. The publications of the Museum consist of Annual Reports, Special Papers and Memoirs.

Instruction is given in General Anthropology; and research courses, with special reference to American Archaeology and Ethnology, are open to students in the Graduate School, and to undergraduates by special permission.

The Serpent Mound Park in Adams County, Ohio, containing the great Serpent Mound, is the property of the Peabody Museum. The park has been laid out as an appropriate surrounding to the important prehistoric monument it contains, and is free to the public under proper restrictions.

In addition to scholarships and fellowships annually awarded on the nomination of the Faculty of Arts and Sciences, several of which are open to properly qualified students in the Department, the following are available only for students in American Archaeology and Ethnology :—

THE HEMENWAY FELLOWSHIP; founded in 1890 by Mrs. Mary E. Hemenway, to be held by a student of Harvard University, pursuing the study of American Archaeology and Ethnology. It is awarded annually by the Trustees of the Peabody Museum to a student in the Graduate School. The Trustees may require the incumbent to render such assistance to the Peabody Professor of Archaeology or the Curator of the Museum as they think fitting. The present annual value of this fellowship is five hundred dollars.

THE THAW FELLOWSHIP; established in 1890 by Mrs. Mary Copley Thaw, in memory of her husband, the late William Thaw, for "work and research relating to the Indian race of America, or other ethnological and archaeological investigations;" to be awarded by the Trustees of the Pea-

body Museum. The present annual income of this fellowship is one thousand and fifty dollars; and is now payable, under certain conditions, by the terms of the gift, to a special student in connection with the Peabody Museum, nominated by the founder.

ROBERT C. WINTHROP SCHOLARSHIP, with an income of two hundred dollars. Established in 1895 from a bequest of five thousand dollars made by Robert C. Winthrop "to my Alma Mater, Harvard College, for a scholarship or scholarships" to "be assigned to the Peabody Museum of Archaeology and Ethnology over which I have presided since its organization." The nomination for this Scholarship will for the present be made by the Trustees of the Peabody Museum.

BOTANIC GARDEN AND HERBARIUM.

GEORGE L. GOODALE, M.D., LL.D., *Fisher Professor of Natural History, and Director of the Botanic Garden.*

BENJAMIN L. ROBINSON, Ph.D., *Curator of the Herbarium.*

CYRUS G. PRINGLE, *Collector for the Herbarium.*

MERRITT L. FERNALD, *Assistant in Herbarium.*

JESSE M. GREENMAN, A.B., *Assistant in Herbarium.*

MARY A. DAY, *Librarian of the Herbarium.*

The Botanic Garden occupies about seven acres of land at the corner of Linnæan and Garden Streets, Cambridge. More than five thousand species of flowering plants are cultivated for educational and scientific purposes. The grounds and greenhouses are open to the public daily, from sunrise to sunset.

To students properly qualified, specimens of flowers and living plants are freely furnished, and facilities are offered for prosecuting investigations. Under certain restrictions students are supplied with all necessary appliances for conducting experiments in vegetable physiology.

The Herbarium, now numbering about two hundred and fifty thousand sheets, including the types described in the Synoptical Flora of North America, is contained in a building at the Botanic Garden. To graduate students properly prepared, it is open for consultation under the direction of the Curator.

The Botanical Library of the Herbarium, containing over eleven thousand six hundred volumes and pamphlets, is accessible for consultation to all advanced students of Botany.

The botanical sections of the University Museum (see p. 576), contain (1) the laboratories of Phanerogamic and Cryptogamic Botany, (2) the extensive Cryptogamic Herbarium, (3) Laboratory Library and Student Herbarium, (4) the Botanical Museum, comprising illustrations of economic botany, as yet not accessible to the public, and the Ware collection of Blaschka glass models of plants.



THE ASTRONOMICAL OBSERVATORY.

FACULTY.

CHARLES W. ELIOT, LL.D., *President.*

EDWARD C. PICKERING, LL.D., *Paine Professor of Practical Astronomy, and Director.*

ARTHUR SEARLE, A.M., *Phillips Professor of Astronomy.*

WILLIAM H. PICKERING, S.B., *Assistant Professor of Astronomy.*

OLON I. BAILEY, A.M., *Assistant Professor of Astronomy.*

OLIVER CLINTON WENDELL, A.M., *Assistant.*

J. RAYNER EDMANDS, S.B., *Assistant.*

A. LAWRENCE ROTCH, A.M., *Assistant in Meteorology.*

WILLARD P. GERRISH, *Assistant.*

This Observatory was founded for the purpose of scientific research in all departments of Astronomy. To fulfil this purpose, it has been equipped with instruments of the first class and with a library of about 20,000 works (of which about half are pamphlets), principally relating to astronomical subjects. It has likewise been provided with funds for the maintenance and increase of its equipment and library, and for the payment of its current expenses, special provision having also been made for the publication of its observations.

One of the principal departments of the Observatory is the Henry Draper Memorial, maintained by Mrs. Draper to permit the study on a large scale of the spectra and other physical properties of the fixed stars.

The Boyden Fund furnishes the means of establishing an observing station at a considerable elevation, to avoid the serious difficulties in observation which arise from atmospheric causes. After preliminary experiments on mountains in Colorado and California, a station was established in the Andes, near Chosica, Peru, under the direction of Professor BAILEY. This has been transferred to a site about 8000 feet high, near Arequipa, Peru, where observations were conducted for two years under the direction of Professor W. H. PICKERING. Professor BAILEY has now returned to Peru and has taken charge of the station. He has recently established a series of meteorological stations crossing the Andes at the respective elevations of 100, 4,150, 8,060, 13,300, 15,600, 19,200, 11,000 and 8,000 feet.

In coöperation with the Blue Hill Meteorological Observatory, under the direction of Mr. Rorich, meteorological observations are maintained, and the results published in the *Annals of the Observatory*. The Blue Hill Observatory is situated upon land recently taken by the State as a public park, but a portion of this land has been leased to Harvard College, in order to ensure the continuance of the meteorological observations.

In coöperation with the New England Weather Service, observations are made at nearly two hundred stations distributed over New England, and the results are published in the *Annals*, which also contain the results of investigations by members of the New England Meteorological Society.

The Observatory is now provided with a photographic telescope of greater size than that of any similar instrument hitherto constructed. This telescope is the gift of Miss C. W. Bruce, of New York. Its object-glass consists of four lenses, each 24 inches in aperture. The work for which it is specially designed is the production of stellar charts and photographs of stellar spectra.

By the mutual consent of astronomers, the Kiel and Harvard Observatories have been selected as the centres for the prompt announcement of astronomical discoveries. For example, when a comet is discovered in America its position is telegraphed to this Observatory, from here to Kiel, and thence to all the principal observatories of Europe.

Forty assistants take part in the work of the Observatory. The results obtained are published in a series of *Annals*, and now fill thirty-three quarto volumes. The preparation of these volumes occupies a large part of the force at the Observatory in Cambridge. Besides this labor, a large amount of observation is done there, several instruments being kept in constant use. The largest of these are the fifteen-inch and six-inch equatorial telescopes, the eight-inch transit circle, the eleven-inch Draper photographic telescope, the eight-inch photographic telescope, and the meridian photometer.

Instruction in astronomy is not given at the Observatory, either by lectures or recitations. Facilities are freely offered to astronomers for making use of the library, buildings, grounds, and instruments of the Observatory, so far as this can be done without interfering with regular work. Similar opportunities are sometimes offered to special students in astronomy, but the constant employment of the principal instruments greatly limits the use that can be made of them for this purpose. Such students may apply for admission to the Director, with whom the fees for the privileges offered may be agreed upon. In some cases a part or the whole of the fees may be remitted in consideration of services rendered in computation.

THE ARNOLD ARBORETUM.

CHARLES S. SARGENT, *Arnold Professor of Arboriculture, Director.*
CHARLES E. FAXON, *Assistant, in charge of Herbarium and Museum.*
JACKSON DAWSON, *Superintendent.*

The Arnold Arboretum was founded for the purpose of scientific research and experiment in Arboriculture, Forestry, and Dendrology, and as a Museum of trees and shrubs suited to the climate of Massachusetts. The Arboretum occupies a portion of the Bussey farm in West Roxbury, 220 acres in extent, and under a special arrangement with the City of Boston, is open to the public every day in the year from sunrise to sunset. The living collections are supplemented by an Herbarium, Museum, and Library.

Any one properly qualified to pursue the study of practical arboriculture or forestry may be admitted to the Arboretum as a student. Such students will be permitted to take part in the work carried on in the Arboretum as well as to make use of its Library. They will also receive from the officers of the Arboretum such assistance and advice in the study of any branch of Arboriculture or Dendrology as can be rendered without interference with current work. In order to study with advantage in the Arboretum, the student should already possess such a degree of botanical knowledge as is implied in a thorough acquaintance with "Gray's Botanical Text Book," or any equivalent work. He must have some knowledge of horticultural methods and practice, and should be familiar with the native trees at least of the New England States.

Application for admission may be made to the Director, with whom the fees for instruction may be agreed upon. Fees may be remitted in consideration of services performed.

UNIVERSITY FACILITIES
FOR
EXERCISE, PHYSICAL TRAINING, AND ATHLETIC SPORTS.

THE HEMENWAY GYMNASIUM.

DUDLEY ALLEN SARGENT, A.M., M.D., S.D., *Director.*

JAMES GRAY LATHROP, *Instructor in Athletics.*

FRANCES DOHS, *Instructor in Gymnastics.*

CLARENCE BERTRAND VAN WYCK, *Recorder.*

The gymnasium, named in honor of **AUGUSTUS HEMENWAY**, of Boston, who gave it to the University, is a handsome and spacious structure, built in 1878 and equipped with the utmost thoroughness.

The growth of the University and the interest in this department during the past fifteen years has necessitated an increase of room and facilities which Mr. Hemenway has met by making an extensive addition to the Gymnasium in 1895.

This new addition affords an increased floor area of 15,000 square feet with locker, bathing and dressing room, accommodations for 2500 students.

An area of some 12,000 square feet of ground immediately connected with the Gymnasium has been enclosed, graded and covered with asphalt, to afford facilities for practising gymnastic exercises and games in the open air.

The Gymnasium proper has a floor space of 30,000 square feet including a large main hall for general exercise, a running-gallery, rowing-room and basement for Bowling Alleys, Hand Ball Courts, and rooms for Fencing, Sparring, Wrestling and other forms of exercises.

The Main Hall is furnished with a large variety of light and heavy gymnastic apparatus and all the best patterns of the modern developing appliances.

The building is lighted throughout by electricity and warmed and ventilated by a novel arrangement of steam pipes, light wells and air shafts.

The Gymnasium is open to all members of the University free of expense, on week days from 11 A.M. to 1 P.M., 3 to 5.30, and 8 to 10 P.M., except on Saturdays, when it is closed at 6 o'clock.

The attendance is voluntary, and the system adopted is one designed to meet the special wants of each individual. Realizing the great diversity in age, size, and strength, as well as in health, of the students who attend the University, the Director makes no attempt to group them into classes which pursue the same course of exercises.

Upon entering the University, each student is entitled to an examination by the Director, in which his physical proportions are measured, his strength tested, his heart and lungs examined, and information solicited concerning his general health and inherited tendencies. From the data thus procured, a special order of appropriate exercises is made out for each student, with specifications of the movements and apparatus which he may best use. These exercises are marked in outline on cards without charge, or in handbooks accompanied by charts, at a small expense. After working on this prescription for three or six months, the student is entitled to another examination, by which the results of his work are ascertained, and the Director enabled to make a further prescription. Students holding scholarships are expected to be examined twice a year; and those desiring to enter athletic contests are required to be examined by the Director and obtain his permission so to do.

In addition to the individual prescriptions, there are classes in Free Movements and Light Gymnastics designed to afford an opportunity for general development to all students of the University who are not members of the athletic teams or who are not in need of specially prescribed exercises.

All students of Harvard University desiring to enter as competitors in Athletic Contests are required to give evidence of their ability by making the following strength tests, in addition to the regular physical examinations: —

Candidates for the University Crew and Foot Ball Team and Weight Throwers are expected to make a total strength test of 700 points.

Candidates for the Class Crews and Foot Ball Teams and Gymnastic, Wrestling and Sparring Contests are expected to make a total strength test of 600 points.

Candidates for the University and Class Ball Nines, LaCrosse Teams, Track and Field Events are expected to make a total strength test of 500 points.

These points are reckoned as follows: — The number of kilos. lifted with the back and legs straight, and the number of kilos. lifted with the legs bent, added to the strength of the grip of the right and left hand, expiratory power as tested by the manometer, and one-tenth of the weight in kilos. multiplied by the number of times that the person can raise his weight by dipping between the parallel bars and pulling his weight up to his chin on the rings. Where the strength test falls below the desired standard the capacity of lungs is taken into account in summing up the condition.

These tests are made and certificates granted on any day, excepting Saturday and Sunday, between 2 and 4 p. m. within two weeks previous to a contest, but no examinations are made or certificates granted on the day of the contest.

COMMITTEE ON THE REGULATION OF ATHLETIC SPORTS.

FACULTY MEMBERS.

JOSEPH H. BEALE, JR., A.M., LL.B., *Assistant Professor of Law.*

IRA N. HOLLIS, *Professor of Engineering.*

EDWARD H. BRADFORD, A.M., M.D., *Assistant Professor of Orthopedics.*

GRADUATE MEMBERS.

AUGUSTUS P. GARDER, A.B.

WILLIAM A. BROOKS, JR., A.M., M.D.

LOUIS A. FROTHINGHAM, A.B., LL.B.

UNDERGRADUATE MEMBERS.

ROBERT H. STEVENSON, JR., *Class of 1897.*

JAMES H. PERKINS, *Class of 1898.*

PERCY D. HAUGHTON, *Class of 1899.*

OFFICERS.

JOSEPH H. BEALE, JR., *Chairman.*

JAMES H. PERKINS, *Secretary.*

NORMAN W. BINGHAM, *Graduate Treasurer.*

The President and Fellows established the Committee on the Regulation of Athletic Sports by the following vote, to which the Overseers consented :—

“ *Voted*, That the following be adopted as one of the standing rules and orders of the President and Fellows and the Board of Overseers :—

“ A Committee for the Regulation of Athletic Sports shall hereafter be annually appointed and chosen as follows : three members of the University Faculties, and three graduates of the College—these six to be appointed by the Corporation with the consent of the Overseers ; and also three undergraduates to be chosen during the first week of the College year by the majority vote of the following students : the Presidents of the Senior Junior and Sophomore classes, and a representative from each of the following athletic organizations : the Boat Club, the Cricket Club, and the Athletic, Base-ball, Foot-ball, Cycling, and Tennis Associations,

who shall be called together for the purpose of making this choice by the President of the University.

"This Committee shall have entire supervision and control of all athletic exercises within and without the precincts of the University, subject to the authority of the Faculty of Arts and Sciences, as defined by the Statutes."

Under the authority thus conferred the Committee exercises a general supervision over the grounds and buildings devoted by the University to athletic sports and exercise; over the times and places of athletic contests; and over the physical condition of those engaged in them. The regulations framed by the Committee forbid the employment of unauthorized persons as trainers, and require intercollegiate and other contests to be held at such times and places as will cause least interference with study. No person is permitted to take part in athletic contests without a physical examination by the Director of the Gymnasium, and his permission so to do. No person who is not a student of some department of the University in full and regular standing is allowed to take part in any athletic contest or exhibition. The Committee chooses its own officers, and appoints a Graduate Treasurer, who exercises supervision over the accounts of all athletic organizations using University grounds or buildings. The Committee makes a report annually to the President of the University.

ATHLETIC BUILDINGS.

Besides the Gymnasium, four other buildings are held, either by the University or by trustees, for the exclusive use of students of the University.

By the gift of Henry Astor Carey, Esq., a substantial brick building was erected in 1889-90 on Holmes field for the use of members of the principal teams. It has a floor area of 7848 square feet.

The University Boat House, situated on Charles River, about half a mile from the College, is used principally by regular crews. It has a floor space of 6893 square feet.

By the gift of George W. Weld, Esq., a second boat house was erected in 1889-90 for the use chiefly of students not rowing on regular crews. It is situated about one third of a mile from the College, and has lockers and boat-storage sufficient for the use of 300 students.

By subscriptions from Alumni the "Locker Building" was erected in 1893-94 on Soldier's Field. This building has a capacity of 1500 lockers, and contains also large shower-rooms and dressing-rooms.

PLAY-GROUNDS.

For out-door exercise, the University and the students themselves have provided three grounds. Holmes Field, adjacent to the Gymnasium and Carey Building, is about 450 feet by 600 feet, and has an unencumbered area of about five acres.

Jarvis Field, a few hundred feet from Holmes Field, is about four acres in area, and is used exclusively by tennis-players.

The gift made to the University in 1890 by Henry L. Higginson, Esq., affords the students an additional play-ground of twenty acres. This new field, called the Soldier's Field, is situated just across the Charles River, and is within easy reach of the College Yard. It is used for foot-ball and other sports. The students have provided upon this field permanent seats for 10,000 persons.

GENERAL SUMMARY.

Government, Teachers and other Officers.

CORPORATION	7
OVERSEERS	31
TEACHERS :—	
Professors	88
Associate Professors	3
Assistant Professors	37
Lecturers	13
Tutors	1
Instructors	135
Demonstrators and Assistants	122
Whole number of Teachers	394
PREACHERS	5
CURATORS AND LIBRARY OFFICERS	14
PROCTORS AND OTHER OFFICERS	34

Students.

I. FACULTY OF ARTS AND SCIENCES :—

1. COLLEGE :—

Senior Class	328
Junior Class	377
Sophomore Class	473
Freshman Class	416
Special Students	160
	—1754

2. SCIENTIFIC SCHOOL :—

Fourth-Year Students	30
Third-Year Students	41
Second-Year Students	94
First-Year Students	130
Special Students	80
	— 375

3. GRADUATE SCHOOL:—

Resident Students	279
Non-Resident Students	16
	<hr/> 295

Whole No. of Students under Faculty of Arts and Sciences, 2424

II. DIVINITY SCHOOL:—

Resident Graduates	16
Senior Class	4
Middle Class	6
Junior Class	8
Special Students	3
	<hr/> 37

III. LAW SCHOOL:—

Third-Year Students	94
Second-Year Students	180
First-Year Students	169
Special Students	33
	<hr/> 475

IV. MEDICAL SCHOOL:—

In Courses for Graduates	29
Fourth Class	72
Third Class	128
Second Class	153
First Class	173
	<hr/> 554

V. DENTAL SCHOOL:—

In Courses for Graduates	1
Third-Year Students	39
Second-Year Students	41
First-Year Students	50
	<hr/> 131

VI. SCHOOL OF VETERINARY MEDICINE:—

Third Class	18
Second Class	17
First Class	11
Special Students	6
	<hr/> 52

VII. BUSSEY INSTITUTION	11
Whole Number of Students	3684
Deduct for names inserted more than once . . .	3
	<hr/> 3681

SUMMER COURSES:—

English	95
German	9
French	16
Education and Teaching	41
Methods of Teaching Geometry, etc.	9
Latin for Teachers	20
Fine Arts	13
Mathematics	35
Engineering	9
Freehand Drawing	5
Physics	46
Chemistry	31
Botany	18
Geology	19
Physiography	53
Physiology and Hygiene	5
Physical Training	104
Medical School	108
Dental School	6
	<hr/> 687
Deduct for names inserted more than once	18
	<hr/> 624

**SCHOOLS FROM WHICH STUDENTS HAVE ENTERED THE
LAWRENCE SCIENTIFIC SCHOOL 1892-96 INCLUSIVE.**

<p>Adams Academy, Mass. Albany High School, N. Y. Albany State Normal, N. Y. Albion College, Mich. Allen Bros.' Private School, Mass. Amherst College, Mass. Arkansas, Indiana University. Arms Academy, Mass.</p> <p>Baltimore City College, Md. Bath High School, Me. Bellows Falls High School, N. H. Belmont School, Cal. Belmont School, Mass. Berkeley High School, Conn. Berkeley School, Boston. Berkeley School, N. Y. Bethany College, W. Va. Blake's, W. S., Private Sch., N.Y. Boston College. Boston English High. Boston Free Atelier. Boston Latin School. Boston University. Bowdoin College, Me. Bridgewater Normal, Mass. Brighton English High, Mass. Brighton Seminary, N. Y. Brookline High School, Mass. Brooklyn Polytechnic, N. Y. Brown University, R. I. Browne & Nichols' Sch., Cambridge. Bryant & Stratton's Sch., Boston. Buffalo High School, N. Y. Bussey Institution, Harvard Univ. B. Y. Academy, Provo, Utah.</p> <p>Cambridge English High School. Cambridge High School. Cambridge Latin School.</p>	<p>Cambridge Manual Training Sch. Case School, Cleveland, O. Central High Sch., Cleveland, O. Charlestown High School, Mass. Chauncey Hall School, Boston. Chauncey High School, Boston. Chelsea High School, Mass. Chem. Bact. Institute, Berlin. Chenault's Private School, Ky. Chicago Manual Training School. Coburn Class. Inst., Waterville, Me. Cohasset English High, Mass. Colby Academy, Me. College of City of New York. College of Pharmacy, New York. Columbia College. Columbia School, S. Orange, N. J. Concord High School, Mass. Condon School, New York. Cornell University. Cutler, A. H., Private Sch., N. Y. Cutler's School, Newton, Mass.</p> <p>DeLancey School, Phila., Pa. Denison High School, Texas. Denison University. DePauw University. Dorchester High School, Mass. Dummer Academy, Mass. Dubuque High Sch., Dubuque, Ia. Durfee High Sch., Fall River, Mass.</p> <p>Gayres, Wm. N., Priv. Sch., Boston. Exeter Academy.</p> <p>Fall River High School. Fisk Univ., Nashville, Tenn. Flushing High School, New York. Fordham College, New York. Foxcroft Academy, Me.</p>
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Franklin College, Indiana.

Friends Acad., N. Bedford, Mass.

Gardiner High School, Me.

Grand Island High, Neb.

Groton School, Mass.

Gunnery Sch., Washington, Conn.

Hale, Albert, Private Sch., Boston.

Harvard College.

Harvard Medical School.

Harvard School, Chicago.

Heathcote School, Buffalo, N. Y.

Hill School, Pottstown, Pa.

Holbrook's Academy, N. Y.

Holderness Sch., Plymouth, N. H.

**Hopkinson, John P., Private Sch.,
Boston. [Mass.]**

Howard High Sch., Bridgewater,

Illinois State Normal University.

Indiana State Normal.

Indianapolis High School, Ind.

Iroton School, Penn.

Jefferson College of Medicine.

Jenner's, Private School.

Kansas State Normal.

**Kendall, Joshua, Private Sch., Cam-
bridge.**

Keene, H. S., N. H.

Keith's, M. S., Private Sch., Boston.

King's School, Stamford, Conn.

Lake Forest Academy, Ill.

**Lausanne, Public School, Switzer-
land.**

Lawrence Academy, Mass.

Lehigh University.

Lehigh University Preparatory Sch.

Lexington High School, Mass.

Louisville College of Pharmacy.

Lowell High School, Mass.

Lynn Classical High, Mass.

Lynn High School, Mass.

Maine State College.

Malden High School, Mass.

Martin School, Pa.

Mass. Inst. of Technology.

Mass. Agricultural College.

Melrose High School, Mass.

Michigan Agricultural College.

Milwaukee High, Wis.

Milton Academy, Mass.

Milton High School, Mass.

Minneapolis High School.

Missouri State Normal.

Mohegan Lake School, N. Y.

Morristown Preparatory Sch., N. Y.

Mt. Herman High School, Mass.

Mt. St. Mary's College, Maryland.

Mt. Allison College, N. B.

New Bedford High, Mass.

New Jersey State Normal.

Newport School, Conn.

Newton Collegiate Inst., Mass.

Newton High School, Mass.

Noble & Greenough's Sch., Boston.

Norwich Free Academy, Conn.

Oberlin College.

Olean High School, N. Y.

Oneonta Normal School, N. Y.

Orono High School, Me.

Patten Academy, Me.

Peabody Normal, Nashville, Tenn.

Peekskil Military Academy, N. Y.

Penn. Military College.

**Perkins', A. C., Private School, San
Francisco.**

Penn. State Normal.

Phillips Academy, Andover.

Phillips Academy, Exeter.

Phoenix High, Salem.

Pittsburg Academy, Pa.

Polytechnic, Brooklyn, N. Y.

Pomfret School, Conn.

Portland High School, Me.

Powder Point School, Mass.

- Pratt Inst., Brooklyn, N. Y.
 Princeton Preparatory Sch., N. J.
 Princeton University.
 Purdue University.
 Racine College, Minn.
 Reading High School, Mass.
 Rensselaer Polytechnic, N. Y.
 Rideout's, Miss, Priv. Sch., Boston.
 Riverview Military Acad., N. Y.
 Rockland High School, Me.
 Roger's High Sch., Newport, R. I.
 Roxbury Drawing School, Mass.
 Roxbury High School, Mass.
 Roxbury Latin School, Mass.
 Rutgers College, N. J.
 Rutgers Preparatory School, N. J.
 Rutland Institute, Vt.
 St. Louis High School, Mo.
 St. Mark's Sch., Southboro, Mass.
 St. Mary's College, Montreal.
 St. Paul High School, Minn.
 St. Paul's Sch, Garden City, L. I.
 St. Paul's School, Concord, N. H.
 Salem High School, Mass.
 Sch. Mining Engin., Univ. of Pa.
 Sheffield Scientific Sch., Yale Univ.
 Smith Academy, St. Louis.
 Somerville High School, Mass.
 Southbridge High School, Mass.
 Springfield High School, Mass.
 State School of Mines, Col.
 Steven's Institute, Hoboken, N. J.
 Stowell's School, Lexington, Mass.
 Syrian Protestant College, Syria.
 Thayer Academy, Mass.
 Titusville High School, Penn.
 Toronto University College.
 Tuft's College.
 Tulane College, N. Orleans, La.
 University of Cincinnati.
 University of Colorado.
 University of Illinois.
 University of Michigan.
 University of Minnesota.
 University of Pennsylvania.
 University Sch., Bridgeport, Conn.
 University School, Chicago, Ill.
 University of Vermont.
 University of W. Virginia.
 University of Wisconsin.
 Urbana University.
 Vermont Academy.
 Virginia Agricultural & Mechanical College.
 Waban School, Mass.
 Wakefield High School, Mass.
 Waltham High School, Mass.
 Warner, B. & S., Business College.
 Watertown High School, Mass.
 Washington High School, Washington, D. C.
 Washington Univ., St. Louis, Mo.
 Wellesley High School, Mass.
 Wesleyan University, Ohio.
 Westbrook Seminary, Mass.
 Westfield Normal School, Mass.
 Westminster School, New York.
 Wm. Jewell College.
 Williston Seminary, Mass.
 Winchester High School, Mass.
 Winthrop High School, Mass.
 Woburn High School, Mass.
 Woodbridge School, New York.
 Worcester Academy, Mass.
 Worcester Classical High, Mass.
 Worcester English High, Mass.
 Worcester Polytechnic, Mass.
 Yale College.



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